Evolution of Quality Infrastructure Investment in Japan
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Paul Kriss, Haruka Miki-Imoto, Hiroshi Nishimaki, Takashi Riku
ABOUT TOKYO DEVELOPMENT LEARNING CENTER

Launched in 2004 in partnership with the government of Japan, the Tokyo Development Learning Center (TDLC) is a pivotal World Bank program housed under the Global Practice for Urban, Disaster Risk Management, Resilience and Land (GPURL). Located in the heart of Tokyo, TDLC serves as a global knowledge hub that aims to operationalize Japanese and global urban development knowledge, insights, and technical expertise to maximize development impact. TDLC operates through four core activities: Technical Deep Dives (TDDs), Operational Support, Insights and Publications, and the City Partnership Program (CPP). For more information, visit www.worldbank.org/tdlc.
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DISCLAIMER AND CONTEXT

This study builds on the G20 Principles for Quality Infrastructure Investment (QII) adopted at the Osaka Summit 2019. It is the first attempt to showcase examples where QII has been operationalized in urban infrastructure projects in Japan. In principle, the case study leverages existing data and evaluations available either in existing literature or through interviews with cities and public organizations.

World Bank TDLC works extensively in areas such as urban infrastructure and urban service delivery and, therefore, it has a ready stock of documentations in the urban sector produced during Phase III (2016 to 2020) of the TDLC Program. To prepare input for the G20 Infrastructure Working Group, the project team reviewed the compiled documents and reclassified the contents through the lens of QII.

The study highlights how Japan has operationalized quality aspects in urban infrastructure. Detailed impact evaluation is not included in the scope of this case study, however, it is an area for future works to address.
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EXECUTIVE SUMMARY

This report reviews the evolution of Quality Infrastructure Investments (QII) in the Japanese urban sector. The report is structured around the six QII principles and the three phases of post-war development in Japan. Specifically, the evolution of the six principles is reviewed in relation to historical events during the periods 1956–73, 1974–90, and 1990–2020. Throughout this report, the six QII principles will be referred to by the following labels:

- **QI-1**: Sustainable development
- **QI-2**: Economic efficiency
- **QI-3**: Environmental considerations
- **QI-4**: Disaster resilience
- **QI-5**: Social considerations
- **QI-6**: Governance

Shortly after World War II, Japan underwent massive investments in infrastructure to spur economic growth. However, the adverse effects of uncontrolled development soon became apparent. In the 1970s and 1980s, Japanese cities had to focus their efforts on addressing urban sprawl and environmental pollution. Recognizing the need for controlled development, the Japanese government made a major revision in the City Planning Law to strengthen infrastructure governance. Beginning in the 1990s, the focus of planners shifted to further development of built-up areas, and governance elements such as public involvement and technical evaluation were incorporated to ensure timely delivery and technical quality. A major challenge during this period was overcoming two devastating earthquakes that occurred in 1995 and 2011. Because of these experiences, disaster prevention and resilience have become core principles in all infrastructure sectors in Japan. Another major challenge is a sharp increase in maintenance demand. The bulk of infrastructure built in the 1960s and 1970s is nearing its expected lifetime. In response, the Japanese government is working to extend the life span of infrastructure assets through enhanced maintenance and the operationalization of life-cycle costing approaches. In addition, Japanese cities are facing one of the most pressing social issues in Japan—an aging population. In response, cities are exploring new approaches to revitalize city centers, to align public service offerings with contemporary demand, and to make cities more elderly friendly.

QII in the urban sector focuses on maximizing long-term benefits from urbanization and economic growth by minimizing undesirable consequences and long-term risks. This review provided insight on how those undesirable consequences and long-term risks affected Japan’s development outcomes over time. The following key lessons were learned during the review:

- **QI-1**: As cities become built up, emphasis will gradually shift from new development to redevelopment of central areas. To further unlock economic potential, cities can utilize unused air and underground space.
• **QI-1, QI-3, QI-6**: Urban sprawl and environmental pollution are two major undesirable consequences that must be addressed by strengthening governance. If they are not dealt with early on, they could become complicated and expensive burdens for cities to deal with.

• **QI-2**: Maintenance and replacement costs for aged infrastructure are inevitable long-term expenditures. By considering life-cycle costs upfront during the planning phase, cities can better plan and phase their maintenance expenditures, delaying maintenance and replacement costs by extending the expected life span of buildings and structures.

• **QI-6**: Public involvement and Comprehensive Evaluation of capital investment proposals become more important as cities mature. Cities should incorporate these elements in their infrastructure governance system; if they are not incorporated, it may cause long project delays and result in corruptive procurement habits.

• **QI-5**: Cities should monitor demographic changes and derive implications for city planning and management. For example, Japanese cities challenged with the adverse effects of population aging, such as deteriorating city centers and gaps between supply and demand of public services, are exploring new countermeasures, such as incentivizing citizens to move into the city center and closing down public facilities in heavily depopulated areas.

• **QI-4**: In preparing for disasters, cities should have an understanding of the full range of consequences, both direct and indirect. To minimize negative impacts, preventing structural damage is not enough—measures to enhance resilience are required.
1. INTRODUCTION

1.1 Background and Objective

In 2019, the G-20 set forth the ‘G20 Principles for Quality Infrastructure Investment,’ which is a set of voluntary, nonbinding principles that reflects the G-20’s strategic direction and aspiration for Quality Infrastructure Investment (QII). These QII principles build on the consensus that infrastructure is a driver of economic prosperity and that quality infrastructure contributes to maximizing the positive impacts of those investments (G-20 2019).

QII has been an important mindset for the Japanese infrastructure sector for two reasons. First, the QII mindset was crucial for Japan to overcome pressing issues and needs at the time. The authors believe that QII development in Japan has not necessarily been deliberate, at least in the early stages. Historically, each of the six QII principles was recognized in response to adverse effects of rushed economic development after World War II or challenges posed by the nation’s unique geological constraints (Box 1.1). Second, attention to quality aspects is and will be critical for Japan to cope with the rapidly increasing demand for infrastructure maintenance. Since the majority of the existing infrastructure stock has been developed around the 1970s, Japan is now beginning to face the issue of infrastructure ageing. The QII mindset is critical for reducing future maintenance costs and maximizing returns from investment in infrastructure.

The key aspect is that Japan has integrated the knowledge and experience gained from the fragmented and chronological developments in the past and is applying them to current and future infrastructure investments in the form of QII. Based on this understanding, this report mainly focuses on national-level events and developments to understand the overarching narrative of QII evolution in Japan. It is intended as the first attempt to provide a holistic view on the evolution of QII in Japan. It is not intended as a detailed guideline for QII implementation but rather as an introduction to the concept of QII through the lens of Japanese history and experience. Municipal-level examples and perspectives including quantitative analysis of cost savings are provided in the Quality Infrastructure Investment Japanese Case Studies “Fukuoka City – Efficient Water Management” and “Toyama City – Compact City Development.”

Throughout this report, the six QII principles will be referred to by the following labels.

- **QI-1**: Sustainable development
- **QI-2**: Economic efficiency
- **QI-3**: Environmental considerations
- **QI-4**: Disaster resilience
- **QI-5**: Social considerations
- **QI-6**: Governance

1.2 Introduction to Post-war Development in Japan

Post-war development in Japan can be best understood in three phases. Shortly after World War II, Japan entered the first phase of high economic growth accompanied by rapid urbanization. From 1956 to 1973, the economy grew at an average of 9.1 percent per annum, and from 1950 to 1970, the population in metropolitan areas grew at an average of 2.5 percent per annum (Figures 11 and 12).
The oil shock in 1973 triggered a transition to a more moderate economic growth and urbanization. In this second phase, the average gross domestic product (GDP) growth rate was 4.2 percent per annum, and the average population growth rate in metropolitan areas was 1.1 percent per annum. This was the phase when the adverse effects of urbanization, including pollution, became apparent, and cities began to address such challenges.

In the 1990s, the bubble economy collapsed and Japan entered the third phase (1991–2020). In this phase, the average GDP growth rate is 0.9 percent per annum and the average population growth rate in metropolitan areas is 0.2 percent. Although population growth in metropolitan

**FIGURE 1.1.**
Three Phases of Post-war Economic Growth

![GDP Growth Rate (1956-2018)](chart1)

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-war Reconstruction</td>
<td>Tackling Adverse Effects</td>
<td>Muddling through Recession</td>
</tr>
<tr>
<td>and Rapid Growth</td>
<td>of Rapid Growth</td>
<td>and Demographic Change</td>
</tr>
<tr>
<td>Avg 9.1%</td>
<td>Avg 4.2%</td>
<td>Avg 0.9%</td>
</tr>
</tbody>
</table>

Source: Japan Cabinet Office 2020

![GDP Per Capita (1960 - 2019)](chart2)

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-war Reconstruction</td>
<td>Tackling Adverse Effects</td>
<td>Muddling through Stagnation</td>
</tr>
<tr>
<td>and Rapid Growth</td>
<td>of Rapid Growth</td>
<td>and Demographic Change</td>
</tr>
<tr>
<td>Current US$ 50,000</td>
<td>Current US$ 45,000</td>
<td>Current US$ 5,000</td>
</tr>
</tbody>
</table>

Source: World Bank national accounts data and Organisation for Economic Co-operation and Development national accounts data
areas is small, the percentage of the national population living in metropolitan areas is increasing steadily. In 2005, the metropolitan population surpassed the population in other areas for the first time. As this trend illustrates, the Japanese economy is becoming increasingly dependent on metropolitan areas, particularly Tokyo. Today, Japanese cities are exploring additional growth opportunities while being careful to not repeat the mistakes made during the rapid growth period.

The three phases of post-war development in Japan can be summarized as follows:

**PHASE 1:** Post-war Reconstruction and Rapid Growth (1956-73)

**PHASE 2:** Tackling Adverse Effects of Rapid Growth (1974-90)

**PHASE 3:** Muddling through Stagnation and Demographic Change (1991-2020)

### 1.3 Report Structure

Each of the three phases discussed in section 1.2 had different priorities and challenges in terms of urban infrastructure development. In Phase 1, the main objective of infrastructure investment was to spur economic growth. In Phase 2, cities had to face the adverse effects of uncontrolled urbanization, including environmental pollution and urban sprawl. At the same time, the government made a major revision to the city planning law, strengthening legal governance over urban infrastructure. In Phase 3, cities are promoting further urbanization while ensuring that additional quality aspects such as life-cycle costs, disaster resilience, social considerations, and transparency in governance are incorporated in projects’ objectives.

Chapters 2, 3, and 4 are each dedicated to a phase within Japan’s post-war development and each chapter explains how the QII principles have evolved in relation to the historical events and context of the phase. Chapter 5 summarizes the lessons learned from Japan’s experience for countries around the globe.
FIGURE 1.3. Summary of Evolution of QII in Japan

Legend

Event

Resulting Change

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-war Reconstruction and Rapid Growth</td>
<td>Tackling Adverse Effects of Rapid Growth</td>
<td>Muddling through Stagnation and Demographic Change</td>
</tr>
</tbody>
</table>


QI-1 Sustainable Development
- Post-war development
- Spur economic growth
- Railway development
- Establish TOD / LVC
- Unlocking of Underground / Air Space
- Utilize unused space

QI-2 Economic Efficiency
- Overcoming resource deficiencies
- Introduce life-cycle costs
- Deterioration of infrastructure
- Operationalize life-cycle costs

QI-3 Environmental Considerations
- Overcoming pollution
- Introduce environmental standards
- Setting legal framework
- Strengthen infrastructure governance
- Issuing public guidance
- Ensure public participation
- Introducing technical evaluation
- Ensure quality

QI-4 Disaster Resilience
- Great Hanshin-Awaji earthquake
- Strengthen prevention
- Great East Japan earthquake
- Strengthen resilience

QI-5 Social Considerations
- Population aging
- Enhance inclusiveness

Source: World Bank data
Note: TOD = transit-oriented development, LVC = land value capture
Box 1.1: Underlying Factors for Evolution of QII in Japan

To fully understand the evolution of Quality Infrastructure Investment (QII) in Japan, it is important to keep in mind the unique constraints the country has faced: scarcity of land, rugged terrains, and frequent natural disasters.

Japan is home to more than 120 million residents in a total land area of 378,000 km². The nation’s average population density is approximately 340 people per km², which is quite high compared with other countries. However, when considering the substantially low percentage of habitable land, Japan becomes one of the densest countries in the world. In fact, only 27.3 percent of land in Japan is habitable; the rest is mostly steep mountains and deep forests. For comparison, 84.6 percent of land in England is habitable, 72.5 percent in France, and 66.7 percent in Germany (Japan, MLIT 2005). Under such conditions, land has always been the scarcest commodity for infrastructure development in Japan. Naturally, land prices tend to be high as well. For example, the average land acquisition cost for highway development in Japan is ¥1.1 billion per kilometer whereas the average for the United States is ¥0.3 billion per kilometer (Japan, MLIT 2005). As a result, legal frameworks and technologies for infrastructure development in Japan have evolved to minimize land requirements.

Rugged terrain results in higher construction costs. For example, 24.6 percent of roads in Japan are either bridges or tunnels, compared with 7 percent in the United States, 4.4 percent in England, 2.6 percent in France, and 10.1 percent in Germany (Japan, MLIT 2005). The geographical condition also causes disasters. Japanese rivers are famous for having steep gradients and rapid flows, which increases the likeliness of floods. And, hillside areas experience frequent landslides.

Floods and landslides are not the only natural disasters in Japan. From 2004 to 2013, 18.5 percent of earthquakes with a magnitude of 6.0 or above occurred in Japan, despite the country having only 0.25 percent of the world’s land area (Japan, Cabinet Office 2015). From 1971 to 2000, an average of 2.6 typhoons per year hit Japan (Japan, MLIT 2005). Such disaster risks have greatly influenced infrastructure development in Japan. For example, earthquake resistance has become a key criterion for buildings, and cities have incorporated various flood prevention measures even in city centers, including large-scale facilities such as underground floodwater discharge channels.
2. PHASE 1

Post-war Reconstruction and Rapid Growth (1956-73)

2.1 QI-1: Infrastructure as a Foundation for Economic Growth

Just after World War II, concentrated investments in manufacturing and heavy industries dramatically changed the lifestyle of Japanese citizens. By the 1950s, not only did people have enough food and clothes but also they witnessed the emergence of modern housing appliances such as telephones, televisions, washing machines, refrigerators, and vacuum cleaners. However, in the late 1950s, rapid urbanization and motorization led to an urgent need for fundamental infrastructure such as housing, roads, and waterworks. The Japanese government recognized that high economic growth could not be sustained without increased investments in infrastructure. As shown in Figure 2.2, the Japanese government largely increased public works expenditures after 1956. By 1965, public works expenditures became more than 20 percent within Japan’s national budget (that is, general account expenditure).

The housing gap in post-war Japan was serious—2.1 million households were destroyed during the war, and coupled with the increase in demand due to urbanization, the total housing deficiency in Japan at the time was 4.2 million households. In 1955, 15 percent of all households and 27 percent of productive households had difficulty securing a house. To address this issue, the government set out the “10-year Plan for Housing Construction” and established the Japan Housing Corporation, a dedicated public corporation, in the same year (Asai 2018). Water supply was significantly expanded as well: the water supply coverage rate increased from 26 percent in 1950 to 88 percent in 1975 (Figure 2.3) (Japan, MLIT 2020a).

Motorization was the key driver for extensive road development. In 1945, there were approximately 140,000 cars owned in Japan. In 1955, the number of cars increased to approximately 920,000. However, roads in Japan were not in good condition at the time (Figure 2.1). Up until then, investment in the transport sector had been focused on railway development, and road development was lagging compared with other industrialized countries. In 1952 and 1953, the government stipulated special laws to facilitate investments. In 1954, the first national road development plan was created to orchestrate development efforts. As a result, the percentage of paved roads increased from 13.6 percent in 1955 to 75.1 percent in 1970. Furthermore, the construction of highways began in 1963, and nearly 2,000 kilometers of roads were constructed by 1975 (Japan, MLIT 2011a).

Without a doubt, urban infrastructure developed during this period became the foundation of Japanese society. However, the rushed development resulted in downsides that would become
After the war, Japan became the world’s factory, but at a cost—little attention was paid to the adverse effects of industrialization and urbanization on the environment. When Rachel Carson published her epoch-making book Silent Spring in 1962, Japan was also facing serious environmental issues. Not until the 1970s and 1980s was environmental awareness nurtured in Japan, paving the way for the government to eventually enforce one of the highest environmental standards in the world. Additional details on how Japan tackled environmental pollution is provided in section 3.1.

In the 1970s and 1980s, land prices increased and the adverse effects of urbanization became apparent. Naturally, many citizens chose to live in suburban areas. A key issue was to prevent the undesirable consequences of urban sprawl such as congestion, pollution, and underutilization of suburban space. Details on how Japan managed urban sprawl is provided in section 3.2.

Four decades after the bulk development of infrastructure during Phase 1, the deterioration of infrastructure became an imminent issue for the Japanese civil engineering society. Anticipating a sharp increase in maintenance and replacement costs, the Japanese government placed a stronger emphasis on infrastructure maintenance and the mainstreaming of life-cycle costing Section 4.2 provides details on Japan’s approach to operationalize life-cycle costing.

![Figure 2.2: Public Works Expenditure from 1946 to 1965](image1)

**FIGURE 2.2.**
Public Works Expenditure from 1946 to 1965

*Source: Asai 2018*

![Figure 2.3: Water Supply Coverage Rate in Japan](image2)

**FIGURE 2.3.**
Water Supply Coverage Rate in Japan

*Source: Ministry of Health, Labour and Welfare*
3. PHASE 2
Tackling Adverse Effects of Rapid Growth (1974-90)

In the 1970s, the adverse effects of rapid growth in Phase 1 became apparent. Perhaps the most noticeable one was environmental pollution. From the 1970s, many cities in Japan began to suffer from water and air pollution, which had serious consequences for the public’s health. In addition to pollution, typical urban challenges were observed including suburbanization and a need for orderly development with an effective urban governance structure. This chapter explains how Japan tackled these adverse effects of rapid growth.

3.1 QI-3: Rise of Environmental Awareness

In the 1970s and 1980s, Japan had to overcome environmental pollution. During the rapid economic development in the preceding 20 years, little attention was paid to the adverse effects of industrialization and urbanization on the environment. Industrial waste was discharged untreated into the rivers, and hazardous chemicals were released into the air, eventually causing water and air pollution. Dams damaged biological ecosystems, and roads caused noise pollution because of increased traffic. This was when environmental awareness was nurtured in Japan, paving the way for the government to eventually enforce one of the highest environmental standards in the world.

3.1.1 Evolution of Policy Instruments

Environmental pollution suddenly became a national issue when pollution-related diseases emerged in heavily industrialized areas (Japan, Ministry of Environment 2020). In particular, the following diseases are recognized as the four major pollution-related diseases in post-war Japan:

- Itai-itai Disease: Cadmium poisoning
- Minamata Disease: Mercury poisoning
- Niigata Minamata Disease: Mercury poisoning
- Yokkaichi Asthma: Petrochemical air pollution

For all four diseases, the number of cases grew in the 1940s and 1950s; the government officially acknowledged them as pollution-related diseases in the 1960s.
By the late 1960s, citizens made it clear that they would not tolerate environmental pollution, even if it meant slowing down economic growth. Driven by this rising public awareness, the Japanese government enacted the Basic Law for Environmental Pollution Control in 1967. This law required local governments to set environmental standards and introduced the “polluter pays” principle for the first time. In 1972, the government enacted the Nature Conservation Law, which focused on preventing the destruction of the natural environment. These two laws proved effective in addressing the environmental issues and they became the foundation for environmental policies at the time.

In addition to legal measures, in 1971 the Japanese government established the Environment Agency as a unified body to oversee environmental matters. The agency was given almost all statutory powers in the field of pollution control and nature conservation and by the mid-1980s it had made remarkable achievements (Sumikura 1998).

As Japanese citizens began to adopt the mass-production and mass-consumption lifestyle in the 1970s, the cause of pollution gradually shifted from industrial waste to household consumption. Because the Basic Law for Environmental Pollution Control and the Nature Conservation Law relied on industrial regulations to control environmental pollution, they soon became inadequate to address contemporary environmental issues. In 1993, the Japanese government enacted the Basic Environment Law to include a wider range of human activities within the scope of environmental policy. The law replaced the Basic Law for Environmental Pollution Control and part of the Nature Conservation Law to become the current active law on environmental policies. The Basic Environment Law lays out three basic principles:

- The blessings of the environment should be enjoyed by the present generation and succeeded to the future generation.
- A sustainable society should be created where environmental loads by human activities are minimized.
- Japan should contribute actively to global environmental conservation through international cooperation.

The law also defines the responsibilities of various stakeholders and the following available policy instruments:

- Environmental consideration in policy formulation
- Establishment of the Basic Environment Plan which describes the directions of long-term environmental policy (This Plan was established on 16 December 1994)
- Environmental impact assessment for development projects
- Economic measures to encourage activities for reducing environmental load
- Improvement of social infrastructure such as sewerage system, transport facilities etc.
- Promotion of environmental activities by corporations, citizens and NGOs, environmental education, and provision of information
- Promotion of science and technology
- International cooperation for global environmental conservation
3.1.2 Environmental Impact Assessment

Following the enactment of the Basic Environment Law in 1993, the government introduced the environmental impact assessment (EIA) to the Japanese civil engineering society by enacting the Environmental Impact Assessment Law in 1997. This law required developers to assess the environmental impact of a project prior to construction. The law was amended in 2011, and today, EIA is a standard practice in Japan (Katatani 2017).

Local governments led the initiative in the early years. Following the first case of Kawasaki City in 1976, local governments began to introduce EIA in the form of local ordinances. Concurrently, the Ministry of Environment was preparing for a national law on EIA, but the initial bill submitted to the Diet in 1981 failed to pass in 1983. In response, the government set a standardized rule through a Cabinet decision: the Implementation of Environmental Impact Assessment. This decision institutionalized the EIA system through administrative measures, but its legal power was limited compared with national law. Thus, EIA was introduced mainly in the form of local ordinances until the EIA Law was enacted in 1997.

Beginning in 1997, the division of roles between the national law and local ordinances was based on project size. Large-scale projects would be handled by the EIA Law, and smaller projects would be handled by local ordinances. However, because of differences in the legislative structure, there was some confusion in implementation with regard to the appropriate EIA modality for each case. After the amendment of the EIA Law in 2011, the gap between the national law and the local ordinances was somewhat filled. Critical revisions include the new requirement for an environmental impact statement at the preparation phase and an assessment report after the review. The integration of national and local initiatives for EIA is still an ongoing process.

3.2 QI-1: Suburbanization and Transit-Oriented Development

One unique characteristic of suburbanization in Japan was that suburban residents relied primarily on railways instead of cars for mobility to and from city centers. Many cities in the world were highly dependent on cars and tried to develop extensive highway networks to cope with the emerging urban sprawl. However, as cities grew in size, the large number of vehicles coming into the central areas led to heavy congestion at the heart of urban agglomeration. Japanese cities were able to mitigate such consequences through railway-led corridor development, which was the forerunner of the now famous transit-oriented development (TOD) and land-value capture (LVC) approach. By integrating the development of railway and housing along the railway corridor, cities can provide high-quality housing with easy access to city centers, thus guiding the orderly development of suburban areas by maximizing economic potential along corridors.

Private railway operators began corridor development on their own as early as 1910—for decades this approach was quite common in Japan. In 1989, the Japanese government promulgated the Act on Special Measures concerning Comprehensive Advancement of Housing Development and Railway Construction in Metropolitan Areas to further promote the corridor development model. In the 1990s, Tsukuba Express became the first project to use this act. Construction took place from 1994 to 2004, and the line now extends 58.3 kilometers, connecting Tsukuba City and central Tokyo (Japan, MLIT 2011b). According to the act, the Tsukuba Express made use of the following two special measures:
- **Stakeholder Coordination to Integrate Housing and Railway Development**
  - Prefectural governments are to create a masterplan with sufficient consultation with city governments and land readjustment agencies.
  - Prefectural governments are to ensure sufficient coordination with implementing agencies such as the national government, railway companies, and construction companies.

- **Comprehensive Land Readjustment Scheme to Facilitate Land Acquisition (see Figure 3.2)**
  - Planners can designate a "Railway Facility Zone" (RF Zone) in the planning stage.
  - Developers can aggregate pre-purchased land and replace them with land inside the RF Zone.

Tsukuba Express proved the effectiveness of the corridor development model by surpassing the anticipated traffic demand at the planning stage. The increased ridership not only increases fare revenue for the railway operator but also attracts private investment for commercial development around transport hubs. By entering the real estate market, private railway companies in Japan have recovered their railway investments from property development and from fare revenues. For example, Tokyu Railway, a leading suburban railway operator in greater Tokyo, earns more than 30 percent of its revenues from its real estate business on a nonconsolidated basis (Tokyu Corporation 2020). However, it should be noted that this project, as with any project adopting the corridor development model, required a significant amount of effort for stakeholder coordination, particularly to resolve land right issues and to synchronize the progress of both railway and housing projects.

**FIGURE 3.2.**
Comprehensive Land Readjustment Scheme

- Planners designate a "Railway Facility Zone" (RF Zone).
- Municipalities and other public agencies purchase land in advance.
- ‘Comprehensive Land Readjustment’ scheme is approved.
- Land use is decided at the same time.
- Pre-purchased land is aggregated and replaced with land inside RF Zone.
- Railway is constructed; commercial development takes place at stations and public facilities are built in surrounding areas.
- Comprehensive city development.

Source: Ministry of Land, Infrastructure, Transport and Tourism
Box 3.1: Land Readjustment Scheme

Land Readjustment (LR) is a popular scheme in Japan that minimizes disparities between existing landowners. Often, infrastructure development involves the expropriation of land and buildings from landowners within a project area. On the other hand, landowners that are not within the project area—but are around it—are likely to benefit from increases in land value. In a LR project, a larger project area is designated, and each landowner within the project area contributes a small portion of land for public use. The land parcels are aggregated into “reserve land” that is either used for construction sites or partially sold for project finance. Furthermore, landowners within the project area allow the re-plotting of their land, thus enabling an orderly redevelopment of the project area. An overview of LR is provided on the left side of Figure B3.1.1.

The City Planning Law, established in 1919, provided the first legal basis for LR in the form of a provision. In 1954, the Land Readjustment Law was stipulated as a law dedicated to LR. From the 1950s to 1990s, because of the rapidly increasing housing demand, the government strongly promoted the use of LR for housing development in suburban areas. In the early 1990s, the bubble economy collapsed. Housing demand decreased as well as land prices. Because projects could no longer rely on reserve land sales as a major source of project finance, the government began to promote the use of LR for projects in city centers such as urban reconstruction and station area development. Recently, LR is often used in combination with the Urban Redevelopment (UR) scheme to promote high-density development. UR allows the conversion of land rights within the project area to floor rights of the newly developed building. An overview of the combination of LR and UR is provided on the right side of Figure B3.1.1.

To date, the Land Readjustment scheme has been applied to approximately 4,000 km2 of land, which is 30 percent of the total urban area in Japan. More specifically, LR contributed to the development of:

- 11,500 km of city planning roads (25 percent of all city roads designated on city plans)
- 150 km² of green parks (50 percent of parks in Japan)
- 950 station-area facilities (30 percent of stations with over 3,000 passengers per day)

Source: World Bank Tokyo Development Learning Center 2017a
Note: UR = urban redevelopment

FIGURE B3.1.1.
Overview of Land Readjustment and Urban Redevelopment
3.3 QI-6: Framework for Urban Infrastructure Governance

Because of rapid post-war urbanization and the challenges that resulted from it, the Japanese government needed a robust governance framework for infrastructure development. Key elements at the time were (a) vertical coordination between national and subnational agencies, (b) horizontal coordination between stakeholders, and (c) capacity building for implementing agencies. The first issue was addressed by a major revision in the City Planning Law. and the other two issues were addressed by the establishment of Special Purpose Agencies.

3.3.1 City Planning Law

The City Planning Law (CPL) was first passed in 1919, but because of rapid post-war urbanization, the law underwent a major revision in 1968. Although it has undergone additional revisions, the 1968 CPL is the current active City Planning Law in Japan. The primary focus of the updated CPL was to control urban sprawl by preventing excess land conversion from rural to urban. At the same time, the revision promoted decentralization by delegating a considerable amount of planning power from the national government to prefectural and city governments. Before the revision, all planning powers were held by the national government alone (World Bank and TDLC 2017b).

The CPL provides three city planning instruments (Japan, MLIT 2003a):

- **Land use regulations (see Figure 3.3)**
  - Twelve land use options are provided, regulating the use, density, and form of buildings (key indicators include floor-area ratio [FAR], building-coverage ratio [BCR], and maximum building height)
  - Development conforming to the designated land use is, in principle, permitted by default

- **Urban facilities**
  - The location and area of urban facilities (such as transport facilities, public space, utilities, schools, hospitals) are stipulated in advance
  - Development activities within the urban facilities area are tightly regulated once stipulated

- **Urban development projects**
  - Multiple project schemes are available to carry out necessary development activities
  - Major schemes include Land Readjustment, Urban Redevelopment, and New Residential Area Development projects

From the viewpoint of decentralization, the major revision in 1968 can be interpreted as a moderate decentralization with close monitoring by the central government. Local governments were given full authority in the planning process, but key parameters such as land use options were predetermined by the central government. Such a governance structure may inhibit local innovations in city planning, however, at the time, it may have been the most pragmatic approach, considering the limited capacity of local governments. Having come out of a somewhat centralized governance structure, local governments—except for mega-cities that had ample experience—had limited expertise in controlling urbanization on their own. By providing a “template” for urban infrastructure governance, the central government was able to smoothly transition to a more decentralized governance structure.
FIGURE 3.3.
Twelve Land Use Options in the City Planning Law

This zone is designated for low rise residential buildings. The permitted buildings include residential buildings which are also used as small shops or offices and elementary/junior high school buildings.

This zone is mainly designated for medium to high rise residential buildings. In addition to elementary/junior high school buildings, certain types of shop buildings with a floor area of up to 150m² are permitted.

This zone is mainly designated for low rise residential buildings. In addition to elementary/junior high school buildings, certain types of shop buildings with a floor area of up to 150m² are permitted.

This zone is designated for medium to high residential buildings. In addition to hospital and university buildings, certain types of shop buildings with a floor area of up to 500m² are permitted.

This zone is mainly designated for low rise residential buildings. In addition to elementary/junior high school buildings, certain types of shop buildings with a floor area of up to 150m² are permitted.

This zone is designated to protect the residential environment. The permitted buildings include shops, office and hotel buildings with a floor area of up to 3,000m².

This zone is designated to allow the introduction of vehicle-related facilities along roads while protecting the residential environment in harmony with such facilities.

This zone is designed to provide daily shopping facilities for neighborhood residents. In addition to residential and shop buildings, small factory buildings are permitted.

Any type of factory can be built in this zone. While residential and shop buildings can be constructed, school, hospital and hotel buildings are not permitted.

This zone is designated for factories. While all types of factory buildings are permitted, residential, shop, school, hospital and hotel buildings cannot be constructed.

Source: Ministry of Land, Infrastructure, Transport and Tourism
The CPL promulgated in 1968 became the foundation for urban infrastructure governance in Japan. Nevertheless, the CPL underwent more than 10 revisions in the following decades to accommodate contemporary needs (Tokyu Corporation 2020). Key revisions include the following:

- **District Plan (1980)**
  - Empowers local governments to impose additional or more detailed restrictions over existing regulations stipulated in the CPL
  - Typically applied to areas of several hectares, often with theme-specific development purposes
  - Must be drafted in consultation with landowners

- **Special District Plan for Redevelopment (1988)**
  - Promote redevelopment of built-up urban areas while ensuring sufficient provision of public facilities such as roads, parks, and other urban facilities
  - Provide bonuses for FAR, land use, and BCR on the condition of including public facilities in the plan

- **Productive Greenery District (1992)**
  - Designate and preserve specified agricultural land when the tax rate for agricultural land within urban areas becomes equivalent to that of urban land

- **Public Participation (2000)**
  - Invite the public to participate beginning with the planning process instead of informing them after the plan has been somewhat consolidated

### 3.3.2 Special Purpose Agencies

Stakeholder coordination is challenging. Often in infrastructure development, differences in protocols or conflict of interests lead to unexpected delays. Urban development requires synchronized development of different types of infrastructure, such as roads, public transit, and utilities. Thus, a delay in one component of a project can trigger a chain of delays, incurring a substantial economic loss for the entire project. In many countries, the standard solution for stakeholder coordination is to establish an independent committee or unit dedicated to coordination.

In Japan, Special Purpose Agencies (SPAs) were legally stipulated for this purpose. At the time, many local governments lacked the internal capacity to undertake complicated coordination work. The SPAs would accumulate project experience in a specific sector and support local governments in the planning, coordination, and implementation of large-scale infrastructure projects. For example, SPAs in the utility sectors would offer expertise in the licensing for excavation and reconstruction of roads as well as the acquisition of permits for water sourcing and effluent discharging. Another example is the Urban Renaissance Agency, which is an SPA with a mandate to address urban and housing agendas in Japan. The Urban Renaissance Agency specializes in stakeholder coordination for projects including land readjustment and the provision of district-wide infrastructure.

An alternative option that Japan could have taken was to build capacity in the private sector. The development of such engineering consultancies did take place in Japan, but only gradually. During the period of rushed infrastructure development, the government did not have time to spare; therefore, establishing the SPAs quickly supplemented the needed capacity in local governments.
For reference, SPAs for major sectors are provided.

- **Housing**: Japan Housing Corporation (established 1955)
  - Developed housing complexes to address the post-war housing shortage
  - Today, it is reorganized as the Urban Renaissance Agency (Incorporated Administrative Agency)

- **Road**: Japan Highway Public Corporation (established 1956)
  - Constructed and maintained highways and toll roads
  - Today, it is functionally and regionally divided and partially privatized (for example NEXCO)

- **Railway**: Japan Railway Construction Public Corporation (established 1964)
  - Constructed and leased / transferred rail infrastructure to Japanese National Railways (current Japan Railways)
  - Today, it is merged into an Incorporated Administrative Agency

- **Sewage**: Japan Sewage Works Agency (established 1975)
  - Constructed sewage infrastructure
  - Today, it is transitioned into a Municipal Joint Agency

### 3.4 QI-4: Pioneers of the Life-cycle Cost Concept

The concept of "life-cycle cost" (LCC) for buildings was first introduced in Japan in the 1970s. According to records, the first application of life-cycle costing was for the procurement of airplane tires by the US Department of Defense in the 1960s. Then, in the 1970s, computer software to calculate LCC for buildings was developed by the US General Services Administration Public Building Services.

Not until the 1990s were specific methodologies and calculations introduced in Japan, and efforts to operationalize LCC began even later—during the 2000s. Until then, the concept was discussed, and the terminology became common, but LCC was not put into practice. In fact, a survey conducted in 2000 showed practitioners’ concerns that “the methodology is ambiguous,” “the data is unreliable,” “there is no point in calculating the uncertain future,” “the results are influenced by changes in economic environments,” and “the approach cannot anticipate technological progress in the future.” As can be implied from those comments, the two major challenges for the operationalization of LCC were (a) accumulating data for running costs and drawing the line between different cost items, and (b) forecasting longitudinal aspects (such as expected lifetime) and adequately setting the discount rate to calculate the net present value (Okuda 2019).

However, there were frontier projects that considered life-cycle costs even during this period. In most of those cases, the act of life-cycle costing was driven by severe resource constraints. Planners carefully compared available investment options to make the best use of limited resources (for example, water), and made capital investments to lower the operational costs (such as sourcing costs). One such example is the water management in Fukuoka City. Situated in a water-scarce environment and having suffered a severe drought in 1978, the city quickly launched an initiative to become a “Water Conscious City.” Among the available options, the city decided to develop a central water distribution center to reduce leakages, thus reducing operational expenditures. This case is detailed in the Quality Infrastructure Investment Japanese Case Studies “Fukuoka City – Efficient Water Management.”
4. PHASE 3
Muddling through Stagnation and Demographic Change (1991-2020)

An important context for understanding Phase 3 is that municipal finance has been hit hard by an ailing national economy. Since the 1990s, many local governments have been faced with fiscal issues that are still persistent today. Amid the long recession, local governments’ expenditures have increased in part because of an aggressive increase in public works by the national government as an economic stimulus. As a result, many local governments are issuing more bonds and withdrawing cash from their reserves to sustain their essential public services. At the same time, the revenue of local governments is decreasing mainly because of a reduction in tax revenues (Japan, Cabinet Office 2001). As a result, the fiscal index3 of an average Japanese municipality is about 0.5, which means local governments are getting only half of what they actually need. This difficult situation was one of the drivers for municipalities in Japan to pursue Quality Infrastructure Investment to better capitalize on limited financial resources.

4.1 QI-4: Rising Awareness of Disaster Resilience

Because of its geographical, topological, and meteorological conditions, Japan is subject to frequent natural disasters such as typhoons, torrential rains, heavy snowfalls, earthquakes, and tsunamis. Planners have always considered disasters in infrastructure planning, but two particularly devastating earthquakes significantly raised disaster awareness in post-war Japan: the Great Hanshin-Awaji earthquake in 1995 and the Great East Japan earthquake in 2011. After the first earthquake, disaster prevention measures were thoroughly applied to all infrastructure sectors. After the second earthquake, planners had to acknowledge that the approach of minimizing damage is necessary in addition to the conventional approach to prevent damage completely. Thus, the planners’ mindset gradually shifted from disaster prevention to disaster resilience.

The Great Hanshin-Awaji earthquake hit Kobe City and its surrounding areas (that is, the Hanshin-Awaji area) on January 17, 1995. The magnitude of the earthquake was 7.2, and the epicenter was directly beneath the Hanshin-Awaji area and only 16 kilometers in depth. The earthquake claimed the lives of more than 6,400 people, many of whom were trapped under collapsed buildings and could not be rescued. Urban infrastructure facilities were heavily damaged as well, severely confining urban functions. In the following years, infrastructure developers quickly incorporated preventive measures.

As for housing, more than 100,000 buildings collapsed and more than 140,000 buildings were severely damaged. Post investigations showed that the revised seismic standards incorporated in 1985 proved effective; however, seismic standards were deficient, and they were revised twice after this earthquake. As for rail, a total of 638 kilometers, including Shinkansen tracks, became unavailable, mainly because of the collapse of viaducts and bridges. In response, Japan Railways (JR) installed an automatic braking system that receives seismic data from quake-
sensing systems buried far off the coasts and activates in the event of a major earthquake. As for roads, 36 sections in 27 routes were blocked because of the collapse of elevated structures and cave-ins. In the following years, road infrastructure across the country was structurally reinforced. Regarding gas, investigations showed that the restoration of the power supply ignited gas leaking from damaged pipes, thus setting fires. On the basis of this finding, gas suppliers throughout the country installed zoning systems and quake-sensitive automatic isolation valves into their pipe networks. Regarding water services, damages to the water distribution pipes hampered firefighting, thus increasing the number of casualties. Moreover, those who experienced the earthquake recall that the lack of water supply was the hardest issue during their time at evacuation shelters. The experience prompted local governments to replace existing pipes with earthquake-resistant ductile pipes having interlocking joints (Japan, Cabinet Office 2000).

On March 11, 2011, the Great East Japan earthquake hit Miyagi Prefecture and surrounding areas. The magnitude of the earthquake was 9.0, and the epicenter was 130 kilometers off the coast and 24 kilometers in depth. The number of deaths and missing persons was nearly 22,000, by far the most significant number among major disasters in post-war Japan. However, the preventive measures taken after the Great Hanshin-Awaji earthquake paid off, and many buildings and structures remained intact after the Great East Japan quake. However, soon after the earthquake, the area was hit by one of the largest tsunamis in recorded history in Japan. When the tsunami reached the coastal areas, it was 8–9 meters in height. The total flooded area was 561 km², which is nine times the size of the JR Yamanote Line (that is, central Tokyo). The tsunami brought devastating damage to buildings and structures and, combined with the earthquake itself, triggered the accident at the Fukushima Daiichi Nuclear Power Plant. The event led to discussions on design standards against tsunamis: How strict should the standard be? Rigid enough to withstand tsunamis that occur once in 100 years? Once in 1,000 years? Can the tsunami in 2011 be regarded as an “unexpected” event? It is not easy to provide definite answers to these questions. Naturally, planners began to discuss how to mitigate the impact of disasters. For example, in construction technology, many research projects focus not necessarily on preventing structure damage but on preventing the collapsed structure from damaging humans. In terms of the law, after 2011, the government revised disaster-related regulations to include elements such as disaster education, survivor support, evacuation plans, and mobility continuity plans (Japan, Cabinet Office 2015).

4.2 QI-2: Urgent Need for Life-cycle Costing

In addition to disaster preparedness, the Great Hanshin-Awaji earthquake raised another pressing issue for the Japanese civil engineering society: aging infrastructure. Before the earthquake, most structural engineers believed that the Hanshin Expressway would withstand a magnitude 7.0 earthquake. However, in reality, a large section of the Hanshin Expressway collapsed. Later investigations found that there were many cracks in the joints of elevated structures. Scientific examinations concluded that the cause was structural fatigue from prolonged stress and overloading. Other prefectures in Japan began investigations and found similar structural damages in their road infrastructure. For example, Tokyo’s Metropolitan Expressway Public Corporation (MEPC; current Metropolitan Expressway Company) announced in 2002 that 1,400 locations were in need of immediate repairs. The issue of LCC suddenly became a matter of harsh reality, not merely a tick-box on the planning paper.
A fatal accident kick-started the infrastructure life extension initiative for LCC. On December 2, 2012, a 138-meter span of the ceiling structure collapsed in the Sasago Tunnel, causing nine fatalities. The cause was the failure of anchor bolts. The Sasago Tunnel was constructed in 1977, and because a large percentage of infrastructure in Japan was constructed in the 1970s, the government feared that the incident was a prelude to a wave of infrastructure failures. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) conducted a survey shortly after the accident and found that about half of all roads, tunnels, river management facilities, and port quays will be over 50 years old in 2033 (Figure 4.1) (Japan, MLIT 2020b).

The government acted quickly. In November 2013, the Basic Plan for Life Extension of Infrastructure was formulated, and line ministries created action plans (that is, the Plan for Life Extension of Infrastructure) accordingly. In April 2014, the Ministry of Internal Affairs and Communications (MIC) announced that local governments would be required to create a Comprehensive Management Plan for Public Facilities as a municipal equivalent of a Plan for Life Extension of Infrastructure (Figure 4.2). In this plan, local governments are to provide: (a) the current status of existing public facilities, (b) an overall maintenance plan, and (c) other noteworthy points (such as citizen engagement, public-private partnerships, private finance initiatives). Furthermore, MIC has provided software to calculate infrastructure maintenance costs, and most local governments have used it in their planning process. As of September 30, 2018, all prefectural governments and 99.7 percent of city governments have created a similar plan.

On the basis of the Comprehensive Management Plan for Public Facilities, local governments can visualize the gap between expected infrastructure maintenance costs and their fiscal situation. For many local governments, the expected costs exceed their current expenditure on infrastructure maintenance, and thus cost reduction measures will be required. MIC provides a variety of options to help local governments meet this requirement. Many local governments plan to reduce costs by 20 to 40 percent by implementing the following levers:

- Transition from breakdown maintenance to preventive maintenance
- Extension of an expected lifetime (for example, 80 years)
- Reduction of total amount of public facilities (that is, infrastructure stock)\(^4\)
- Utilization of private sector expertise and finance

**FIGURE 4.1**
Percentage of Infrastructure Stock over 50 Years Old

![Percentage of Infrastructure Stock over 50 Years Old](image)
4.3 QI-1: Enabling Further Development in Built-up Areas

Cities are the engine of economic growth, but most Japanese cities were already built up by the 1990s. To increase the economic potential of urban cores, the government introduced special measures to enable further development in built-up areas. In other words, the government encouraged developers to tap into the unused air and underground space in the city centers.

4.3.1 Urban Reconstruction Law

In 2002, the government promulgated the Act on Special Measures concerning Urban Reconstruction (Urban Reconstruction Law). This law allows the national government to designate certain areas as urgent urban reconstruction areas. Within these areas, highly flexible private-led urban reconstruction is promoted through special exemptions in the city planning process and financial support. Specifically, the following exceptions are available:

- Designation of an Urban Reconstruction Special District where the preset land use and floor-area ratio (FAR) are no longer applied
- Empowerment of private developers to make city plan proposals (city planning decision [that is, approval or rejection] must be made within six months after the proposal)
- Fast-track approval of specified reconstruction projects

The Urban Reconstruction Law provides private developers with an attractive opportunity to increase FAR and maximize returns. At the same time, it also requires them to make social contributions such as the development of public space, pedestrian decks, disaster prevention facilities, and environment-friendly facilities. As of April 2019, 91 districts designated as Urban Reconstruction Special Districts were approved in Japan. The list includes Japan’s symbolic areas such as Tokyo Station, Shinjuku, Shibuya, Yokohama, Osaka, and Nagoya (Japan, Cabinet Office 2020b).

Furthermore, reflecting the need to cope with increasingly frequent and devastating disasters and to revitalize city centers, the Urban Reconstruction Law was amended in February 2020 to direct development efforts within the urgent urban reconstruction area toward more disaster resilient and livable cities. The following are key revisions to the law:
• **Disaster Resilience**
  
  o Restrict new development activities within disaster-prone areas (that is, red zones in hazard maps)
  
  o Promote population shift away from disaster-prone areas

• **Livability**

  o Promote the development of walkable public space
  
  o Relax regulations on land use and FAR for public facilities essential for daily lives (such as hospitals)

This recent amendment showcases how the Urban Reconstruction Law can be used to quickly incorporate contemporary planning needs into key development projects in Japan. Before the amendment, the law primarily focused on balancing the densification and development of public space and facilities. Now, the quality aspects of disaster resilience and livability are incorporated as well (Japan, MLIT 2020c).

### 4.3.2 Deep Underground Law

New development of underground infrastructure becomes increasingly difficult as cities are built up. If existing pipes or cables are damaged during construction, it could lead to water or gas leaks or power outages. Large-scale excavations could interfere with aboveground urban activities such as road traffic and trouble nearby residents with noise, vibrations, and dust.

After decades of extensive infrastructure development, the underground space of Japanese cities is crowded with utility pipes, cables, subways, tunnels, and even debris like steel sheet piles. Over the years, the Japanese civil engineering society developed and continually improved technologies to use deeper underground space and to minimize the excavation area in projects. Two exemplary technologies are shield tunneling and jack pipe pushing. Shield tunneling is used mainly for tunnels, and jack pipe pushing is used mainly for sewage pipes. For both technologies, the only excavations required are the vertical pits in the starting and ending locations. From the starting pit, the tunnel or pipe is constructed horizontally. In shield tunneling, the front of the shield machine digs and the rear of the shield machine constructs the tunnel walls. In jack pipe pushing, pipe sections are pushed one after another from the starting pit. An illustration of shield tunneling and jack pipe pushing is provided in Figure 4.3 (Chiken Enterprise 2020).

In the 1990s, the technology was already developed, but one obstacle for the public use of underground space was the lack of a legal definition for property rights of underground space. Technically, the depth beyond the reach of foundation piles of any superstructure should not cause any harm to the property owners, but there was no law to draw a clear line. In 2000, the national government enacted the Act on Special Measures for Public Use of Deep Underground (Deep Underground Law) to designate “deep underground” as public space. Deep underground is defined as space deeper than typical basement floors (that is, 40 meters) or 10 meters deeper than building-foundation piles, whichever is deeper. After the government passed the Deep Underground Law, five projects used deep underground spaces: the Kobe large-capacity drainage pipe, the Tokyo Outer Ring expressway, the Tokyo-Nagoya high-speed maglev train, the Osaka expressway, and the Osaka Yodogawa River control (Japan, MLIT 2020d). This trend may continue as conducting works in crowded areas becomes more disruptive and costly. Although there is still the need to further validate safety aspects through long-term monitoring of deep underground structures themselves and the potential influence on surrounding and aboveground structures, the Deep Underground Law may allow further use of deep underground in the future. This trend may continue as conducting works in crowded areas becomes more disruptive and costly.
4.4 QI-6: Ensuring Transparency in Governance

Because of land rights issues as well as increasing public awareness of environmental issues, implementations of large-scale infrastructure projects were delayed, even during the stagnating economy of the 1990s. Realizing the importance of early consensus, MLIT issued guidelines to strengthen public involvement in the planning process of infrastructure projects. The issuance of these guidelines triggered the transition from the conventional professionals-led planning model to the public accountability-oriented planning model, which now is mainstream in Japan.

In 2003, MLIT issued the “Guidelines on Public Involvement Procedures in the Planning Phase of Public Works Projects under MLIT Jurisdiction.” The guidelines require planners to incorporate public involvement through the following procedures:

1. Prepare and disclose multiple project plans

2. Take measures to understand public opinions (such as post on websites, host informative sessions, allow submission of written opinions)
   - Disclose information on the background, content, and pros and cons of all project plans
   - Secure enough time to build consensus
   - Disclose procedures, schedules, and key decisions made

3. Establish organizations to facilitate the process
   - For councils (whose members are academia and stakeholders), aggregate submitted opinions and coordinate
   - For third-party organizations (whose members are academia), provide objective advice on the public involvement process and discussions on the project plans.

4. Decide on one project plan and disclose submitted opinions, responses, and the decision process
Before the guidelines were issued, citizens were provided information only after the project plan had been formulated. After the guidelines were issued, planners were required to formulate plans in consultation with citizens. In 2008, MLIT further standardized the public involvement process by issuing the “Guidelines on Planning Procedures in the Planning Phase of Public Works Projects.” These guidelines required planners to: (a) understand and define the scope of “residents and stakeholders”; (b) select an appropriate mode of communication; and (c) ensure mutual communication for each project stage. MLIT also issued sector-specific guidelines for rivers in 1998, for roads in 2002 (revised in 2005), and for ports and airports in 2003.

A key driver behind the transition was the bitter experience in the construction of Tokyo’s “three ring expressways”: Central Ring Road, Outer Ring Road, and Metropolitan Inter-city Ring Road (see Figure 4.4). As shown in Figure 4.5, multiple sections of the Central and Outer Ring Roads took decades to proceed from the initial planning phase to project approval. The delays were mainly because of the lack of coordination among stakeholders, particularly residents along the planned routes. However, the Hokusei Line in the Yokohama Ring Road, which was the first highway construction project to fully incorporate the guidance issued in 2003, took just 7 years from initial planning to project approval. At the final informative session before construction began, there was zero opposition from the residents. This example illustrates how adequate public involvement can significantly accelerate infrastructure projects.

Originally planned in 1963 as part of a “3 ring 9 radial” network, the three ring expressways aimed to alleviate congestion and to secure a pathway for emergency vehicles in the event of disasters. Throughout the project, the development of radial routes preceded that of ring routes, thus forcing all passing traffic to go through the very heart of Tokyo. The early completion of the ring roads became a key priority.

The Outer Ring went through City Planning Decision in 1966, but in 1970, the minister of Construction suspended some sections of the project, announcing that “the project should not be forced upon before arrangements for sufficient public dialogue are put in place.” As this comment implies, the suspended sections faced stiff opposition from communities along the route. The residents were concerned that the elevated structure of the planned highway would cause air pollution and noise. Similar to the Outer Ring, the Central Ring failed to pass the City Planning Decision in 1970 because of opposition from residents.

A breakthrough was the City Planning Decision for the Kumanosho-Ohashi section of the Central Ring in 1990. The Metropolitan Expressway Public Corporation (MEPC; current Metropolitan Expressway Company) adopted an underground structure instead of an elevated structure for the relevant sections. Although the change incurred additional costs for MEPC, it played a critical role in persuading and gaining support from residents. The section acquired project approval in 1991. Following this event, the other delayed sections of the Central and Outer Rings were restarted, and MEPC paid attention to public opinions and made changes to the initial plan when necessary. The Ohashi-Oi section of the Central Ring was approved in 2006. The Tomei-Oigumi section of the Outer Ring was approved in 2009.

In contrast, the Hokusei Line in the Yokohama Ring Road achieved smooth project approval by incorporating public opinions from the beginning of the project. In 2003, MEPC announced it would begin the project with the public involvement process, in accordance to the guidelines issued in 2003. In 2004, MEPC disclosed six preliminary plans and requested residents to submit opinions. It repeated the process in 2005 with seven preliminary plans, one of which was chosen at the end of the year. Following environmental assessments, the plan went through City Planning Decision in 2011 and was approved in 2012. Construction was completed in 2020 (Japan, MLIT 2012).
EVOLUTION OF QUALITY INFRASTRUCTURE INVESTMENT IN JAPAN

4.5 QI-6: Quality Assurance through Procurement Reforms

Today, in principle, Comprehensive Evaluation is applied to all infrastructure development projects in Japan. Under this system, technical and execution capabilities of eligible firms are evaluated, plans have room to suggest technological improvements, and qualified firms submit technical proposals to improve operations or the quality of buildings and structures. The final decision on firm selection is made on the basis of both the technical aspects and the proposed cost (Figure 4.6). Since the first introduction of Comprehensive Evaluation to infrastructure projects, continuous efforts have been made to improve and mainstream this approach to ensure the technical quality of infrastructure (Japan, MLIT 2015).

Comprehensive Evaluation was first applied in 1998 in response to the frequent occurrence of corruptive incidents in the 1990s. However, in the following years, the method was used only for several projects per year. A key turning point was the promulgation of the Act on Promoting Quality Assurance in Public Works (Quality Assurance Law) in March 2005. This law gave firm legal grounds for the Comprehensive Evaluation method by (a) articulating the responsibilities of...
both the contractor and the eligible firms; and (b) by legally defining Comprehensive Evaluation as a method where “the contract will be awarded to the firm who provides the best price and quality.” In September of the same year, a dedicated committee (the Committee) issued the “Guidelines on the Use of Comprehensive Evaluation in Public Works Projects.” The guidelines state that “Comprehensive Evaluation is to be applied to all infrastructure projects except for particularly small projects. Depending on the characteristics of the project (for example, size, room for technical improvement), contractors are to select from three available evaluation types: Simple Type, Standard Type, and Advanced Technical Proposal Type.” As one can easily imagine, the guidelines significantly accelerated the mainstreaming of Comprehensive Evaluation. The application rate of Comprehensive Evaluation grew from 16.9 percent in 2005 to 97.1 percent in 2007.

After the Quality Assurance Law of 2005, the Comprehensive Evaluation method underwent numerous revisions to cope with rising issues. The operationalization of Comprehensive Evaluation in local governments proved to be one of the most challenging issues. Local governments often lack technical staff, thus making it difficult for them to review technical aspects of a submitted proposal. In 2007, the Committee proposed the introduction of a “Simplified Type for Municipalities,” which later became the “Special Simplified Type,” which does not require the submission of an execution plan and evaluates technical aspects solely on the basis of track record and experience in similar projects.

In 2013, although the local capacity issue was not the only driver, MLIT issued the “Guidelines on Operationalizing Comprehensive Evaluation in Public Works Projects under MLIT Jurisdiction.” This guidance reorganized the existing three evaluation types into two types: the Executional Capabilities Type and the Technical Proposal Type. Under each type, there are subcategories. The guidelines reduced the administrative burden of both the contractor and eligible firms and simplified evaluation criteria to refocus the method to quality aspects of infrastructure. The renewed Comprehensive Evaluation system is the foundation for the current system used in Japan (Ishihara, Morita, and Kubo 2014).

FIGURE 4.6.
Overview of Comprehensive Evaluation System in Japan

Source: Tokyo Metropolitan Government, Bureau of Construction.
4.6 QI-5: Accommodating an Aging Population

Population aging is one of the most pressing issues for Japanese society today. The percentage of the population older than 65 sharply increased from 10.3 percent in 1985 to 28.1 percent in 2018. By 2065, the number is expected to increase even further to become nearly 40 percent (Figure 4.7) [Japan, Cabinet Office 2019].

Japanese cities are struggling to accommodate this demographic change. The impact is unusually large in second-tier and third-tier cities located in rural areas. As students and young workers move into large cities, particularly Tokyo, their home cities are faced with the difficult tasks of revitalizing city centers and becoming more elderly-friendly. Innovative approaches are required to tackle these challenges.

Toyama City is addressing this issue as a part of its Compact City initiative. With strong initiative by the mayor, the city is taking an integrated approach to transport and urban planning. By promoting development in the city center and along transit corridors, the city is successfully encouraging citizens, particularly elderly citizens, to get out of their homes and enjoy exterior activities. Details on this case are provided in the Quality Infrastructure Investment Japanese Case Studies “Toyama City – Compact City Development.”

**FIGURE 4.7.**
Population Ageing in Japan

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Population</th>
<th>Over 75</th>
<th>Aged 65-74</th>
<th>Aged 15-64</th>
<th>Aged 0-14</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>100,000</td>
<td>10,000</td>
<td>5,500</td>
<td>10,000</td>
<td>8,000</td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>1,000,000</td>
<td>120,000</td>
<td>66,000</td>
<td>120,000</td>
<td>96,000</td>
<td></td>
</tr>
</tbody>
</table>

Source: Japan, Cabinet Office 2019
5. LESSONS LEARNED

Quality Infrastructure Investment (QII) is about maximizing long-term benefits from urbanization and economic growth by minimizing undesirable consequences and long-term risks. This review on the evolution of QII in Japan provides anecdotal insight on how these undesirable consequences and long-term risks have affected infrastructure development in Japan. This chapter presents lessons learned following the structure shown in Figure 5.1.

Unlocking Economic Potential with Redevelopment Projects and Vertical Expansion

As cities become built up, emphasis will gradually shift from new development to redevelopment of central areas. Having completed a large part of new development in the 1960s and 1970s, Japan focused on the utilization of unused air and underground space for further development. Legal interventions enabled highly flexible private-led development in built-up areas and the public use of deep underground to avoid damaging existing underground assets. Technological progress has been a key enabler for the use of underground space, which aims to minimize interference in aboveground urban activities such as road traffic.

Mitigating Sprawl and Strengthening Environmental Governance

Urban sprawl and environmental pollution were the major undesirable consequences of post-war urbanization in Japan. The negative impacts became apparent soon after rapid urbanization took place and hindered further growth for nearly two decades. Addressing these issues requires strong infrastructure governance. For urban sprawl, the Japanese government made a major revision in the City Planning Law to control excess development activities. For environmental pollution, the Japanese government introduced industrial regulations and expanded the scope of environmental policies to include a wider range of human activities. The environmental impact assessment is an important policy instrument for environmental governance over infrastructure development.

Extending Lifetime of Infrastructure Assets through Enhanced Operations and Maintenance

An inevitable long-term cost is the maintenance or replacement of aged infrastructure. In Japan, the post-war construction boom resulted in a sharp increase in maintenance demand 40 to 50 years later. By considering life-cycle costs upfront in the planning phase, cities can better plan and phase their maintenance expenditures. Moreover, if the expected lifetime of the building or structure is extended as a result of life-cycle costing, cities can benefit from a delay in maintenance or replacement costs.

Improving Transparency with Public Involvement and Comprehensive Evaluation

As a city matures, citizens become more aware of the pros and cons of public works around them, and firm contracting tends to become relation-based rather than competition-based. Japan faced this issue in the 1990s when projects were delayed because of public opposition and corruptive incidents. Addressing these issues requires the strengthening of infrastructure governance—which is exactly what Japan did when it introduced an improved guideline on public involvement and the Comprehensive Evaluation system in the 2000s.
Reacting to Demographic Changes

Social trends are a long-term risk as well in the sense that the gap between contemporary planning needs and the existing city grows larger if no considerations are made. In Japan, population aging is one of the most pressing social issues. Cities are now exploring new planning approaches to adapt to the demographic changes they are facing and to better manage the aging and decline of population.

Preparing for Wider Consequences of Disasters

To minimize the negative impact of disasters, cities must try to understand the range of consequences, both direct and indirect, and prepare accordingly. After experiencing a devastating earthquake in 1995, Japanese planners mainly focused on disaster prevention; however, strong buildings were not enough to protect the lives of people from the earthquake and tsunami in 2011. Recently, emphasis is shifting from disaster prevention to disaster resilience. Buildings are designed to prevent collapsed structures from damaging humans, and the government is preparing various evacuation and continuity plans and raising public awareness.

FIGURE 5.1.
Key Considerations for Quality Urban Infrastructure and their Impact Over Time

![Diagram showing key considerations and their impact over time.]

Source: Original figure for this publication
6. APPENDIX

Project Examples

Two specific infrastructure projects are provided to illustrate the Quality Infrastructure Investment (QII) principles at the project level. The Yamate Tunnel example highlights QI-1 (sustainable development), QI-2 (economic efficiency), and QI-3 (environmental considerations) by shedding light on innovative technologies for underground development and measures to reduce air pollution. The Shibuya example highlights QI-1, QI-4 (disaster resilience), and QI-6 (governance) by presenting the densification of the city and the rail relocation project that was necessary in the process.

Yamate Tunnel (QI-1, QI-2, QI-3)

Yamate Tunnel refers to the western sections of Tokyo’s Central Ring Road (see Figure 4.4). It is the longest road tunnel in Japan with a total length of approximately 18.2 kilometers. The tunnel runs under Yamate Street, which is one of the busiest roads in Tokyo. The route passes Shinjuku and Shibuya, which are both Tokyo’s symbolic areas, and the underground spaces are heavily crowded with pipes and cables. In addition, the route intersects with 13 railway lines. The construction of Yamate Tunnel is a good example of how innovative technologies enabled the development of large-scale underground infrastructure and reduced construction costs. Furthermore, the Metropolitan Expressway Company (MEC), the project owner, took into account environmental considerations and prevented serious air pollution.

Innovative Technologies for Underground Development (QI-1 & QI-2)

MEC was able to reduce construction costs by adopting the ‘U-turn method’ for shield tunneling. A major challenge in the construction of Yamate Tunnel was that the tunneling works had to be divided into many small sections that were shorter than 1 kilometer because Yamate Tunnel had to follow the complex route of Yamate Street, which required MEC to change diameters for each section of the tunnel. This fragmentation of tunneling sections led to a significant increase in capital expenditures for construction because in general, a shield machine must tunnel more than 1 kilometer to be economically viable. However, by adopting the U-turn method, the same shield machine constructed both the inner and outer tunnels by rotating the shield machine 180 degrees at the end of the assigned section (Figure A.1). Of the nine sections constructed by shield tunneling for this project, the shield machine was rotated horizontally in four sections and vertically in one section. The cost reduction effect is estimated to be ¥15 billion (MEC 2020a).

![Figure A.1. U-Turn Method](source: Metropolitan Expressway Company)
Another innovative technology that led to significant reductions in cost and time was the “advanced tunnel enlargement method.” This method allows the construction of junctions with minimal excavation after the shield tunneling is completed. Specifically, the two parallel shield tunnels are connected with arch-shaped segmental linings from the surface (Figure A.2). The cost reduction effect is estimated to be ¥122 billion. Other major benefits include shorter construction periods and reduced negative impacts on surrounding environments (MEC 2020b).

The “neighboring works method” was essential in constructing the tunnel through a jungle of existing underground assets. The most famous example is the construction through a narrow vertical gap between two metro lines, the Marunouchi Line above the tunnel and the Oedo Line below the tunnel. The distances between the tunnel and the metro lines were only 2 to 6 meters on both sides. Prior to tunneling, the ground above was reinforced with beams and piles to support the tracks of the Marunouchi Line. While tunneling through the overlapping section, MEC closely monitored the subsidence of metro-related structures at the millimeter order. In this way, MEC ensured that the tunneling did not damage surrounding underground assets (MEC 2020c).

**FIGURE A.2.**
Advanced Tunnel Enlargement Method

**Reduction of Air Pollution (QI-3)**

To avoid serious air pollution, MEC installed devices and filters to prevent suspended particulate matter (SPM) (specifically dust, fumes, mist, and dust with a diameter smaller than 10 micrometers) and nitrogen dioxide (NO2) from being released into the air. The SPM removal device reduced SPM by more than 80 percent, and the NO2 filter reduced NO2 by more than 90 percent. As a result, the amount of pollutants in the emitted gas is less than 0.5 percent of the national environmental standard. Furthermore, MEC is closely monitoring the removal rate of SPM and NO2 to ensure the devices and filters are functioning properly (MEC 2020d).

**Shibuya (QI-1, QI-4, QI-6)**

Shibuya is one of the most symbolic areas in Tokyo. It is often referred to as the town of youngsters and is the epicenter for Japanese pop culture. At the same time, Shibuya is a key gateway for suburban commuters coming into Tokyo from the Yokohama direction. In fact, a total of nine railway lines pass through Shibuya Station, operated by four different railway operators. Recently, the area underwent extensive redevelopment, adopting densification and transit-oriented development (TOD) as key approaches. Furthermore, the Shibuya River was also redeveloped into a more attractive and disaster-resilient waterfront area.
Densification for Enhanced Economic Potential (QI-1)

At the turn of the century, Shibuya quickly became home to an increasing number of information technology (IT) startups due to the IT bubble at the time. In response, the local government quickly formulated a plan for massive urban transformation to become a new IT business hub. The plan included the creation of 70 hectares of new floor area. Because Shibuya was already heavily built up at the time, the only possible approach was vertical expansion. The local government collaborated with Tokyu Corporation, a leading suburban railway developer, to launch a total of nine high-density redevelopment projects around Shibuya Station. These projects fully used TOD principles for consensus building and land value capture. All of the projects will be completed by 2027 (see Figure A.3 for an illustration of the future Shibuya Station).

Railway Track Relocation in 3.5 Hours (QI-6)

One of the most difficult operations in the redevelopment of Shibuya Station was the connection of two metro lines, the Tokyu Toyoko Line and the Tokyo Metro Fukutoshin Line. This operation required the relocation of 273 meters of railway tracks from overground to underground at Daikanyama Station, which is one station away from Shibuya Station. To avoid interrupting daily operations, Tokyu Corporation had to complete this work within the four hours between the last train and first train. Furthermore, because the area was residential, Tokyu Corporation could not use temporary tracks for the relocation. Instead, it adopted the newly developed STRUM method, in which new track is pre-constructed and quickly connected with existing track.

Figure A.4 provides an illustration of the track relocation work at Daikanyama Station. First, Tokyu Corporation pre-constructed the new railway tracks right underneath the existing railway tracks (red section in Figure A.4). As soon as the last train left Daikanyama Station at 1:00 am, 1,200 engineers began their work. Two sections (yellow sections in Figure A.4) were removed entirely, one section (pink section in Figure A.4) was jacked up temporarily to make way for the trains, and the section leading out of Daikanyama Station (green section in Figure A.4) was jacked down to connect with the pre-constructed tracks. With this method, Tokyu Corporation successfully completed the complex work before the daily test run at 5:00 am. The entire operation took only 3.5 hours. Tokyu Corporation put in an enormous amount of effort in the preparation phase to completely avoid interruptions in daily railway operations and related urban activities, which is important for transport hubs like Shibuya Station.

FIGURE A.3.
Future of Shibuya Station

Source: Tokyo Corporation
River Restoration and Flood Prevention (QI-4)

The literal translation of "Shibuya" is "bitter valley." As the name suggests, the area is located at the bottom of a valley, and flood management has always been a key agenda in city planning. However, despite the preventive measures, Shibuya recently experienced several inundations due to increasingly heavy rainfalls. In response, the local government had to enhance flood protection measures. Specifically, the local government decided to relocate part of Shibuya River to circumvent Shibuya Station and to construct a flood retardation pond with a capacity of 4,000 m³, large enough to endure precipitations of more than 75 millimeters per hour (Tokyo Metropolitan Government Bureau of Construction 2020).
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END NOTES

1 Throughout this document, “Comprehensive Evaluation” refers to the Japan-specific evaluation system “総合評価落札方式” comprising technical and price scores; it is not intended as a general term.

2 The standard Land Readjustment scheme is explained in Box 3.1.

3 Fiscal index = standard financial income/standard financial demand. Municipalities with a fiscal index higher than one are financially self-sustainable.

4 “Reduction of total amount of facilities” refers to the replacement of capital expenditures with the lifetime extension of public facilities. Specifically, extending the lifetime of public facilities can (a) enable demolition or sale of unnecessary facilities, (b) reduce reconstruction, and (c) reduce new construction (Tokyu Corporation 2020).

5 Throughout this document, “Comprehensive Evaluation” refers to the Japan-specific evaluation system “総合評価落札方式” comprising technical and price scores and is not intended as a general term.

6 To view a video of the 3.5-hour track relocation work of the Shibuya Bunka project, see https://www.youtube.com/watch?v=whbZqQlra9k.