TOD Planning to Implementation
– Case of Japan –

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2. Different Types of TODs
   - Assessing TOD Potential
3. Framework for TOD Planning and Implementation
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5. Access Improvement for TOD
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Chapter 1

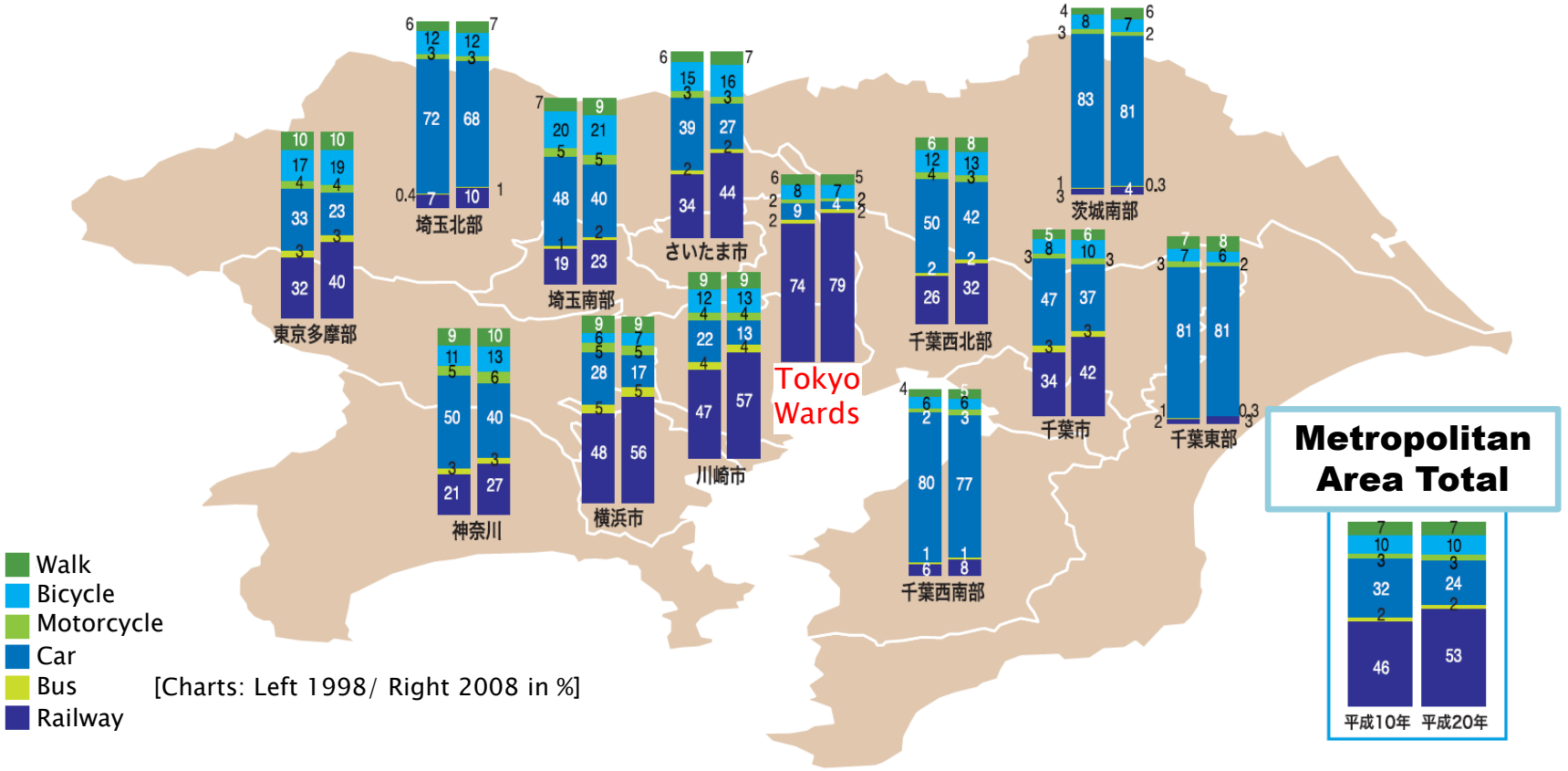
INTRODUCTION

HOW ARE TRANSIT AND LAND USE INTEGRATED IN TOKYO?

1. Introduction: High Public Transport Mode Share

Tokyo and its surrounding areas are highly reliant on public transport.

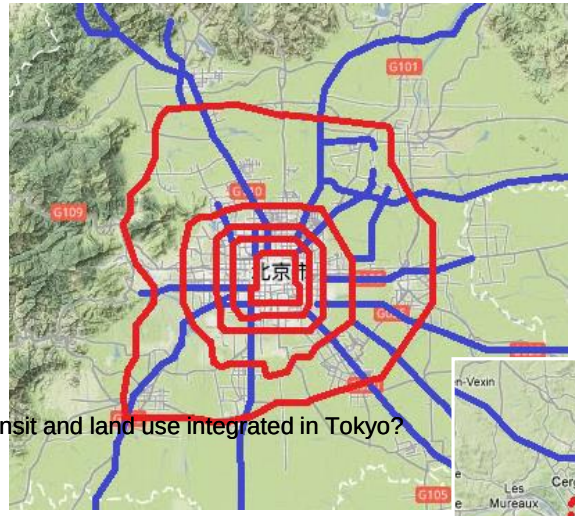
Modes of Commute Travel in Tokyo Metropolitan Area (2008 and 1998)



Even in the metropolitan area (34M population), more than 50% of commuters use railway. The mode share is about 80% within the wards of Tokyo (8M population).

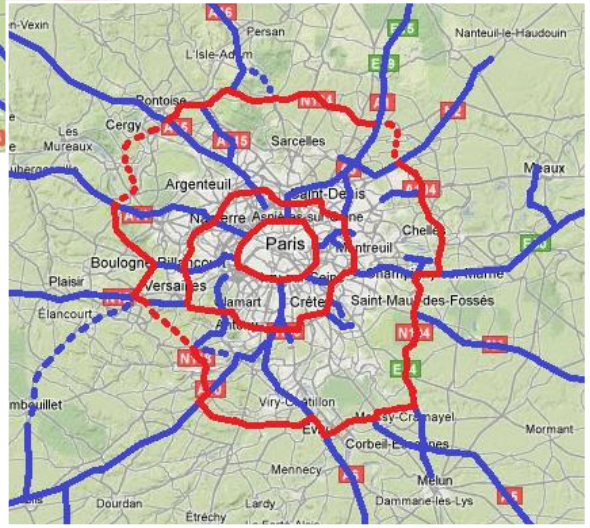
1. Introduction: Road Network in Tokyo

Tokyo's road network is poor compared with other big cities in the world.

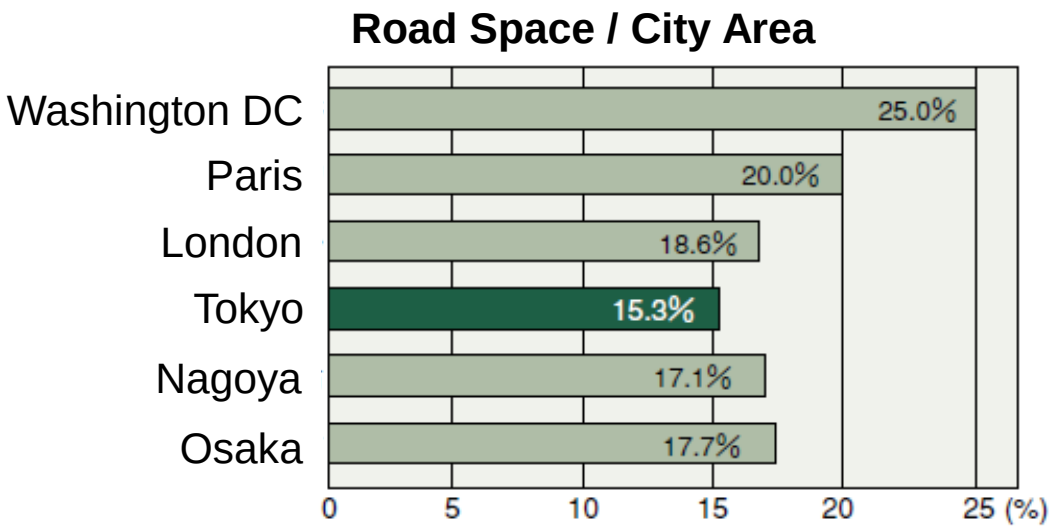


Beijing

Paris

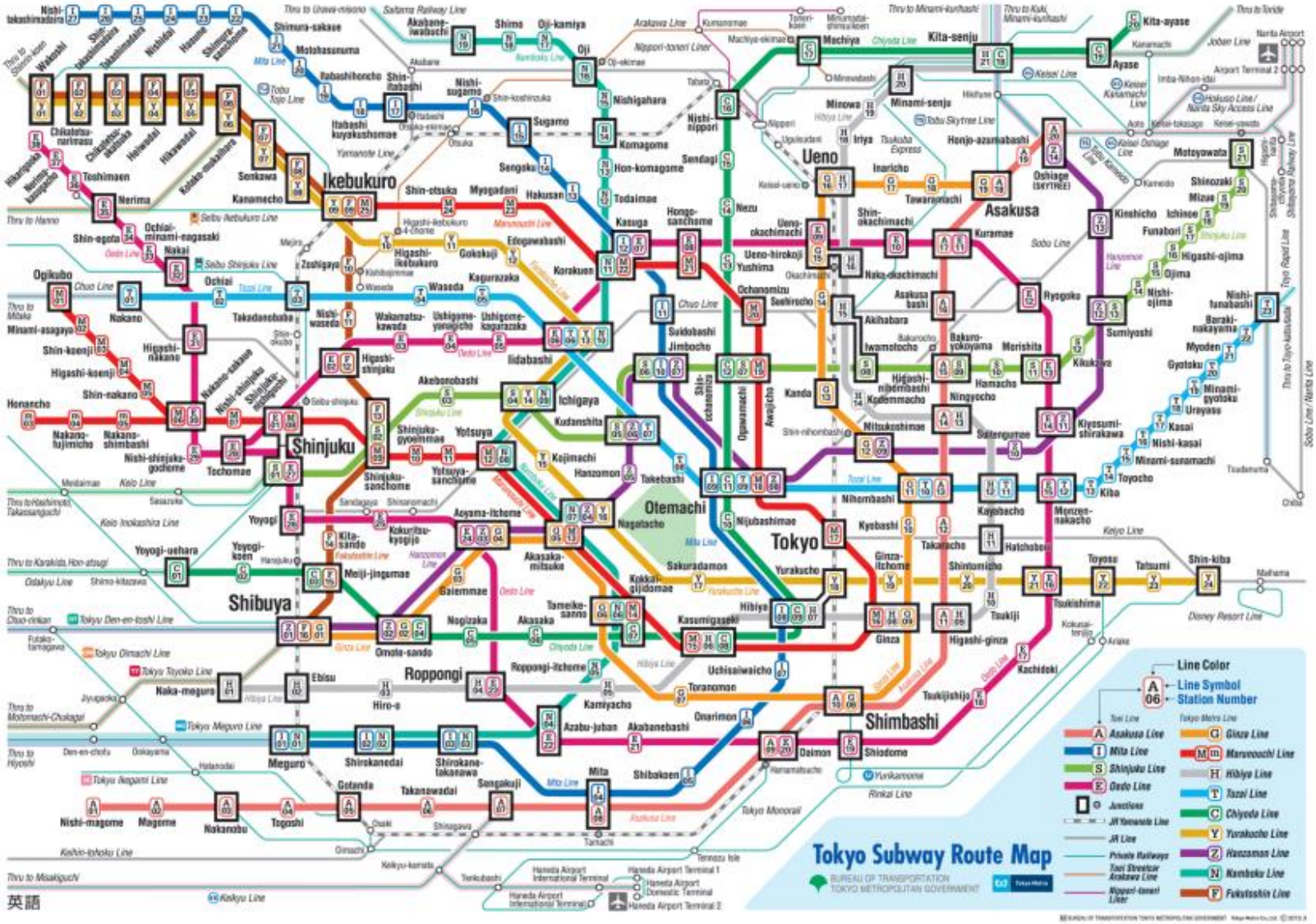


1. How are transit and land use integrated in Tokyo?



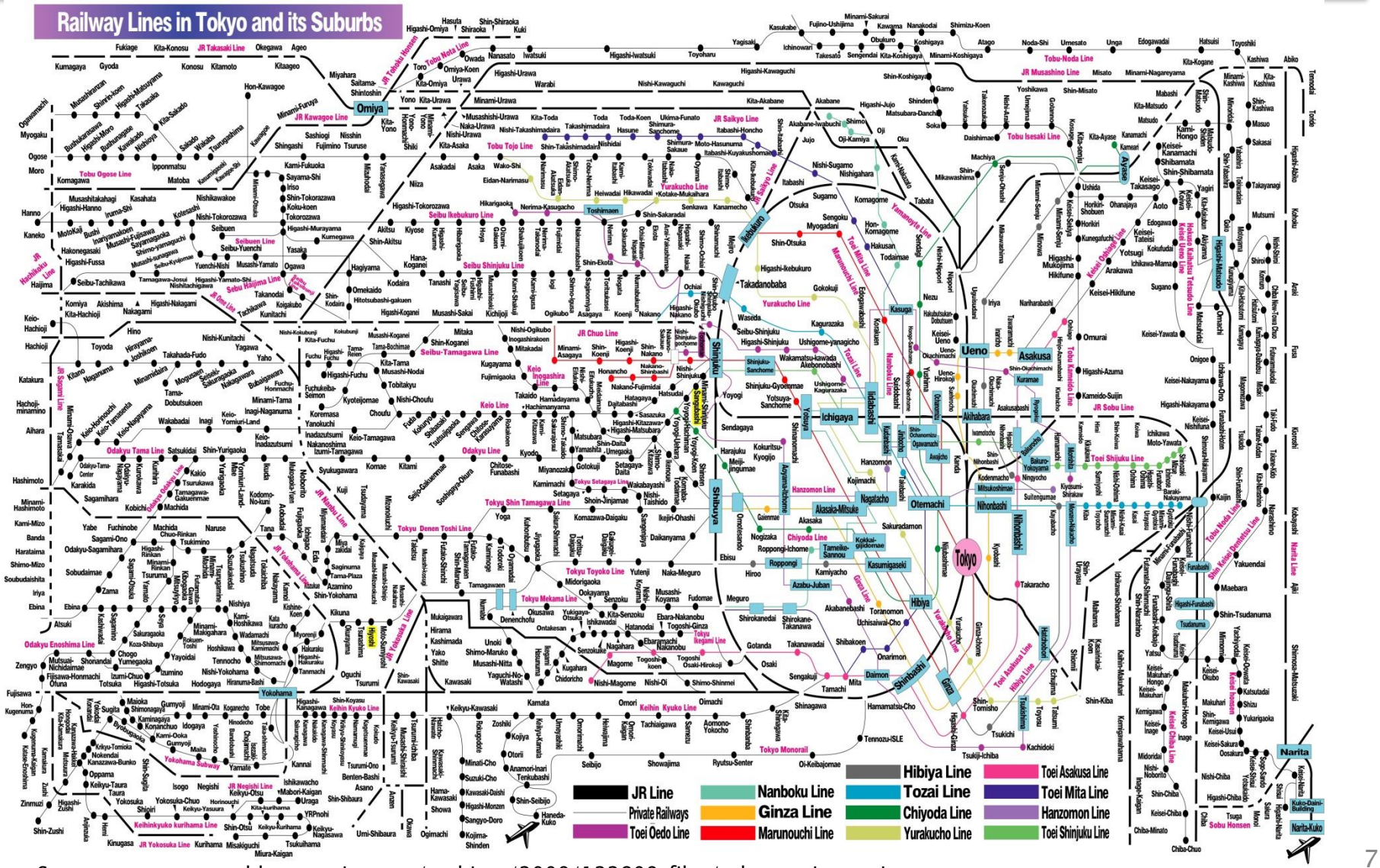
1. Introduction: Subway network in Tokyo

Central part of Tokyo has highest railway density in the world.



1. Introduction: Railway Network in Tokyo

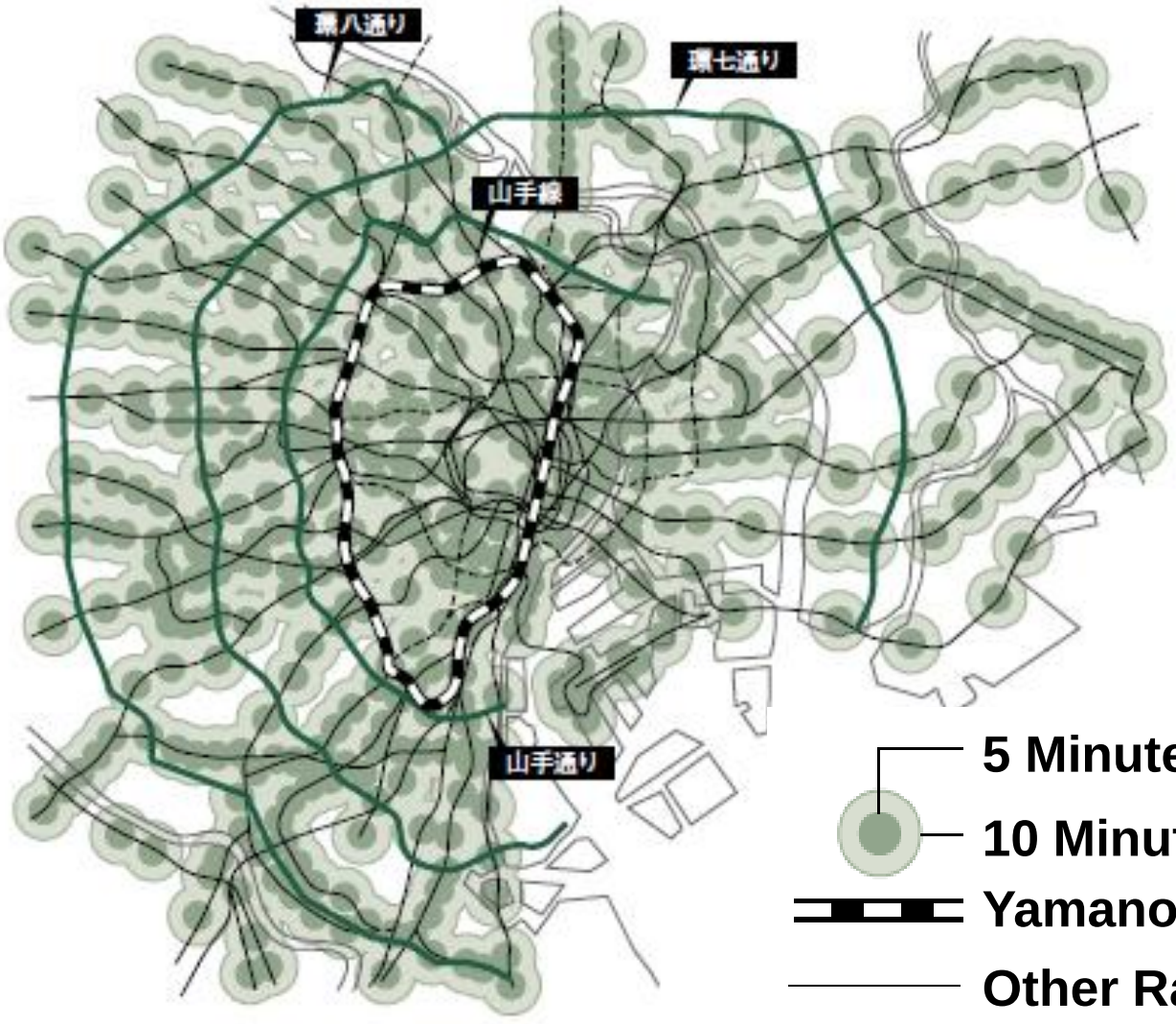
JR East, 2 major public, 9 major private, and many other minor railway operators serve the metropolitan area



Source: www.newworldeconomics.com/archives/2009/122809_files/tokyo_trainmap.jpg

1. Introduction: Railway Catchment in Downtown Tokyo

Inside the Yamanote loop line (35km, 29 stations), everywhere is within walking distance from station.



5 Minutes Walk (400m)

10 Minutes Walk (800m)

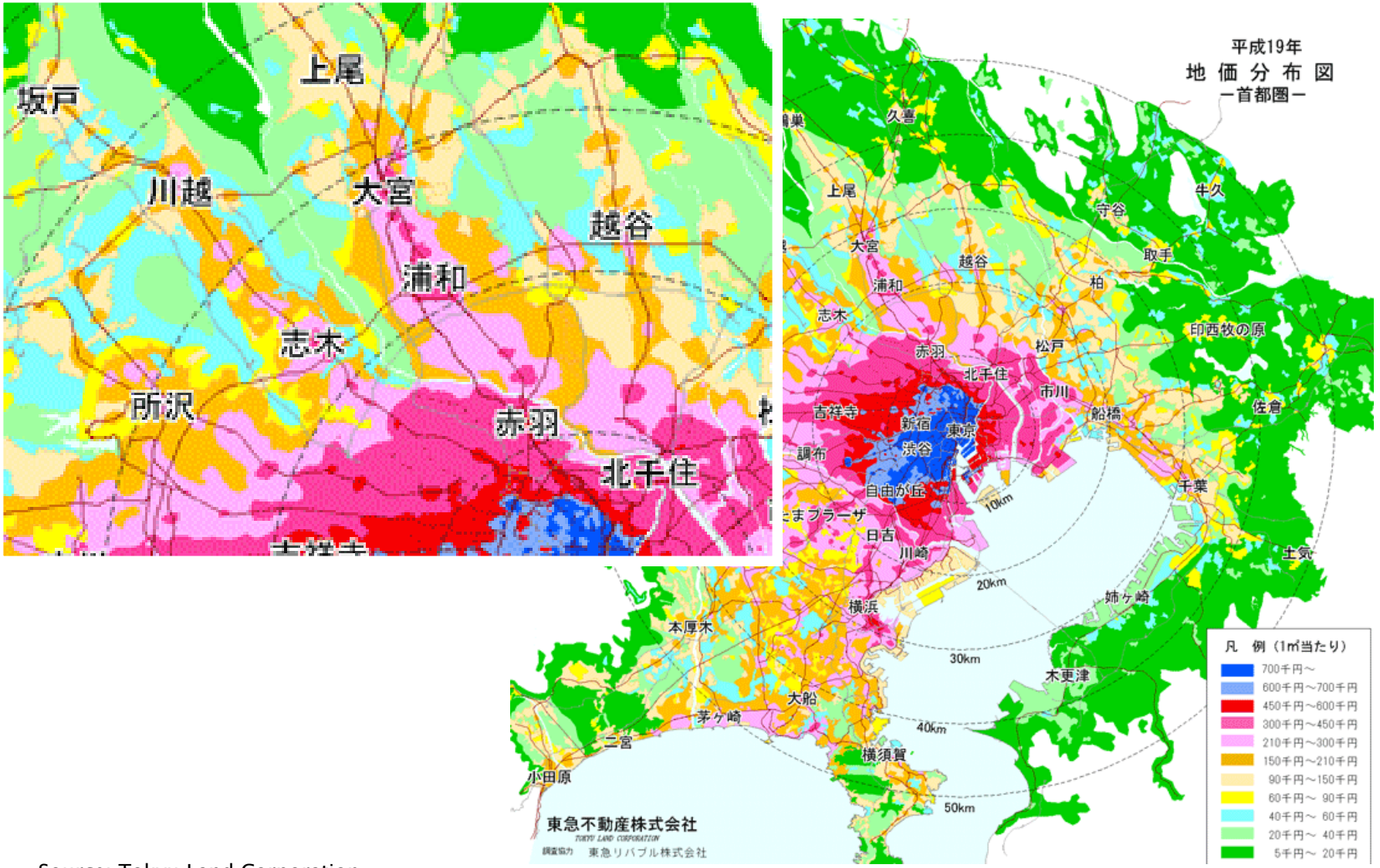
Yamanote Loop Railway

Other Railway Line

Railway under construction

1. Introduction: High mode share translates into high land price

Land price is high along railway lines.

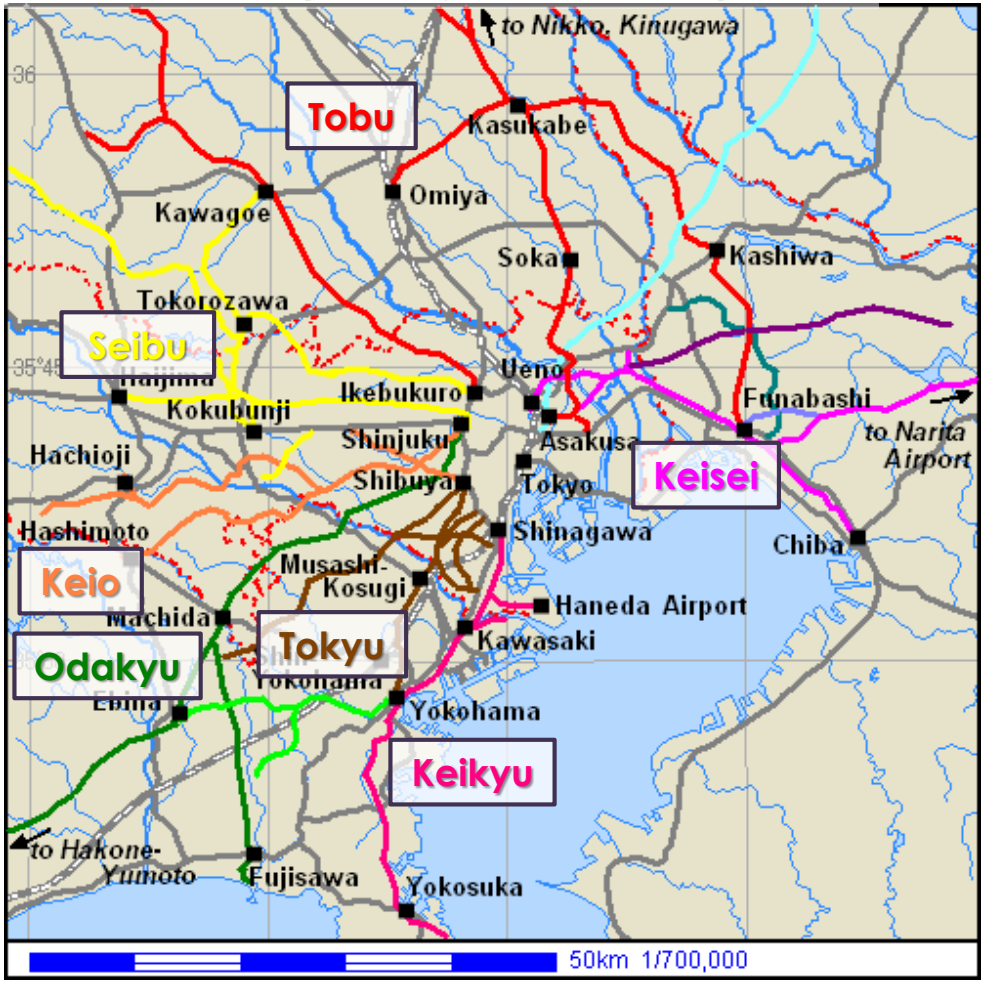


Source: Tokyu Land Corporation

1. Introduction: Private Railway development

Private railways actively developed their network from early 1900s, following Hankyu's business model.

Private Railway Companies in Tokyo



http://www.travel-around-japan.com/j15-private-railroad.html

Tobu started operation in 1899 for 40km section. By the end of WWII, Tobu had more than 550km network. The network has popular tourist spots and hot springs on one end, and department store on the other end.

Seibu started in 1894 and developed 1,172ha of residential land by the end of WWII. It was a child company of one of the largest real estate developers in Japan.

Source: Wikipedia,
Yajima and Ieda, 2014. Global City Tokyo Developed by Railway

1. Introduction: Public railway sector

Trunk lines and subway network were developed and operated by public agencies.

Japan National Railways (JNR)

- JNR was a public corporation under Ministry of Transport.
- While JNR's main business was long distance service, it completed the basic urban network in Tokyo before WWII and also made significant efforts to reduce congestion in 60s and 70s by adding tracks (quadrupling).
- JNR was privatized (corporatized) in 1987 by dividing into six regional companies (Japan Railways, such as JR East) and one freight rail company, when its accumulated debt reached JPY 37T (≈10% of GDP).

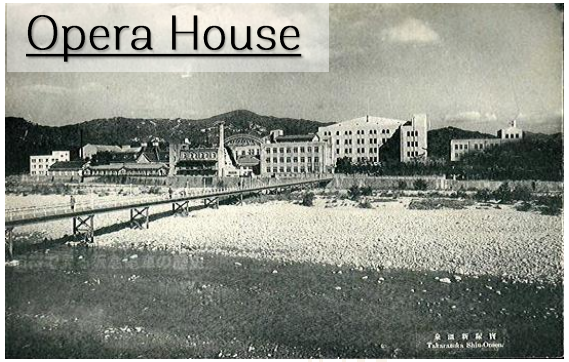
Tokyo Metro

- The first subway line was developed by a private company in 1927. Nearby department stores contributed the cost for the development of stations.
- In 1941, Teito (imperial capital) Rapid Transit Authority was established and took over all the existing lines and permits for future new lines.
- As a part of restructuring of national agencies, Teito was corporatized in 2004 to become Tokyo Metro, whose shares are held jointly by National and Tokyo Metropolitan Government at 53:47.
- Tokyo Metro has 9 lines, 195km, and carries 6.8M passenger/day.

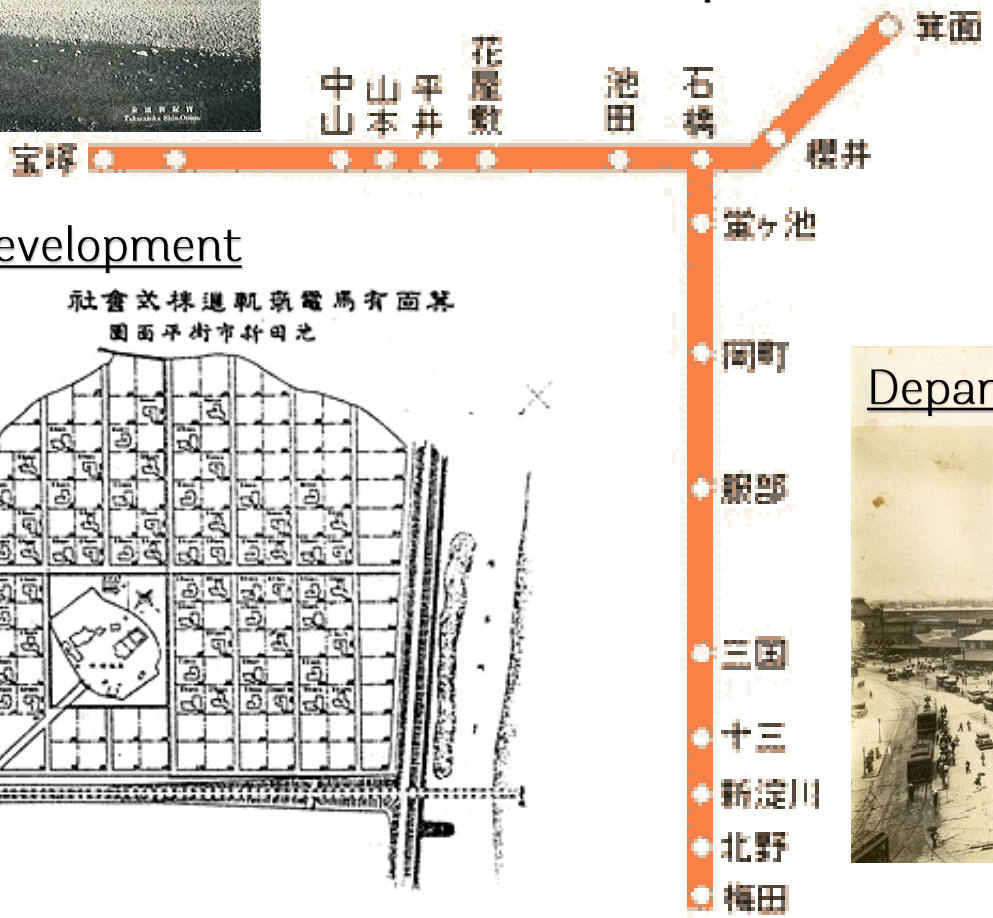
2. History: Business Model of Private Railways

Hankyu Railway undertook a combination of urban development along its suburban line construction in 1910s.

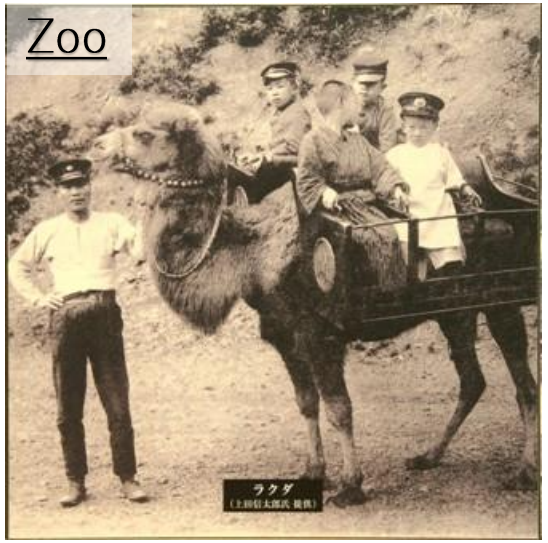
Opera House



1910 Railway opened (25km + 4km)
1910 Ikeda Development (10ha, 200 units)
1911 Takarazuka Spa and Minoh Zoo
1914 Takarazuka Opera
1915 Umeda Terminal Department Store



Zoo



Residential Development

Department Store

Chapter 2

DIFFERENT TYPES OF TOD'S

ASSESSING TOD POTENTIAL

Question #1: What do you want to do?

Different level of interventions:

Base case: FAR change.

- Consolidation of land parcels so that high density development actually happens.
- Improved station access roads and walkways so that the station coverage area expands.
- Creation of open space, community space, park and transit plaza.
- Rearranging land ownership pattern so that efficient land use can happen with proper infrastructure plan.
- Land Value Capture to recover the cost for transit.

Question #2: Who are the landowners?

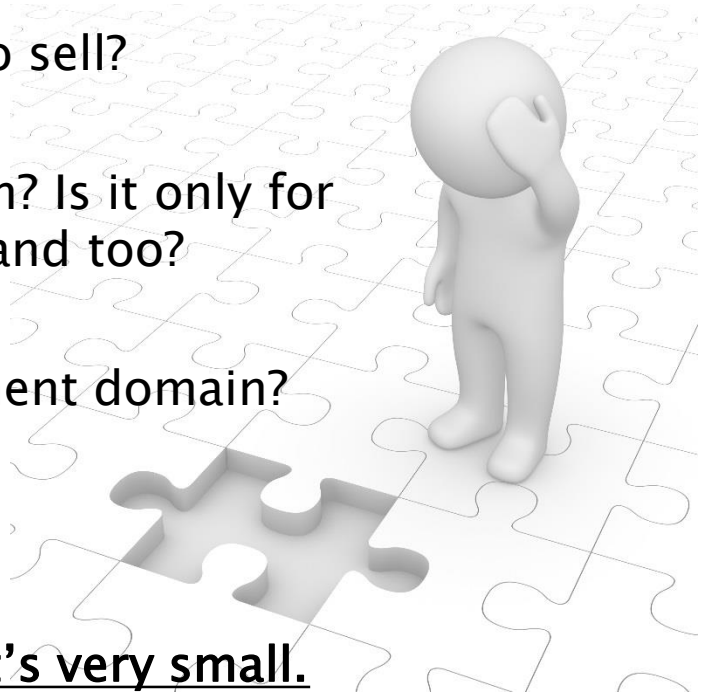
http://www.mb-survey.jp/newlycategory_2/index_3.html

What you want to achieve may or may not require land acquisition. How much land do you need? Are you the landlord of the big parcel around the station?

So, you want to acquire land?

Then the questions:

- How much does it cost? Will it be within a practical level?
- How long does it take? Does it fit with the timeline of implementation for the transit project?
- Are there any incentives for landowners to sell?
- Do you have the power of eminent domain? Is it only for infrastructure, or for non-infrastructure land too?
- Can you really exercise the power of eminent domain?
- Are there any alternative schemes?

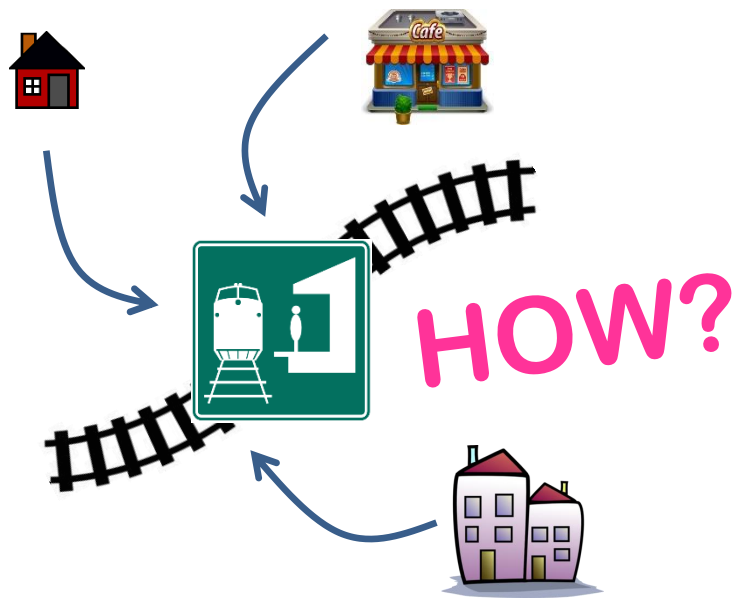


Every piece of land is as important, even if it's very small.

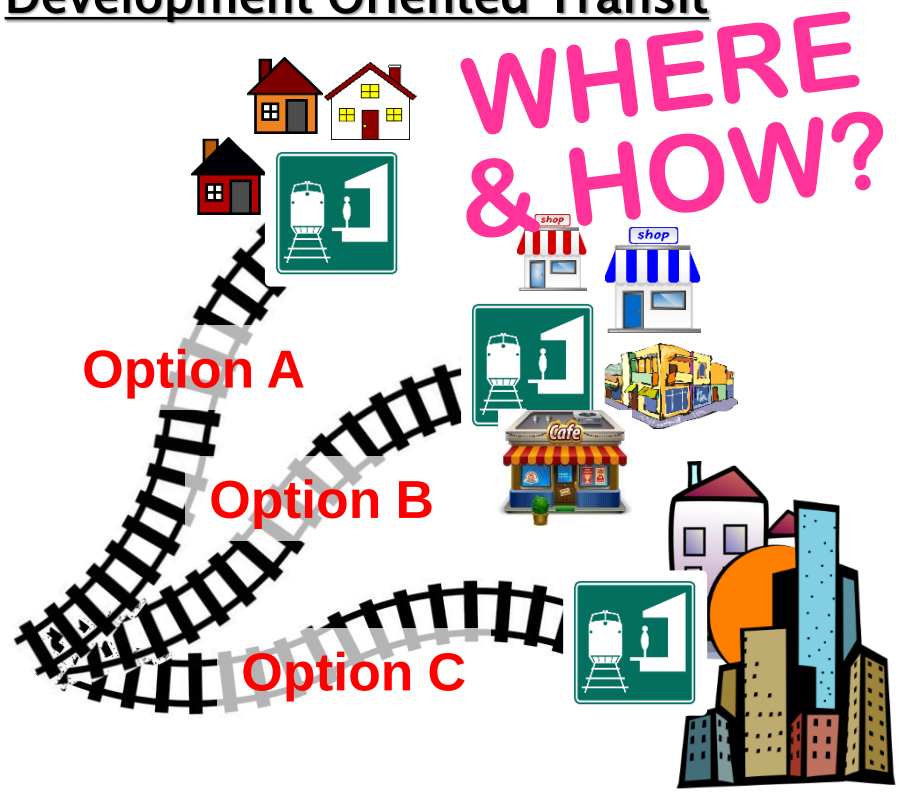
2. Types of TOD's: Assessing TOD Potential

Is it TOD or DOT?

Transit Oriented Development

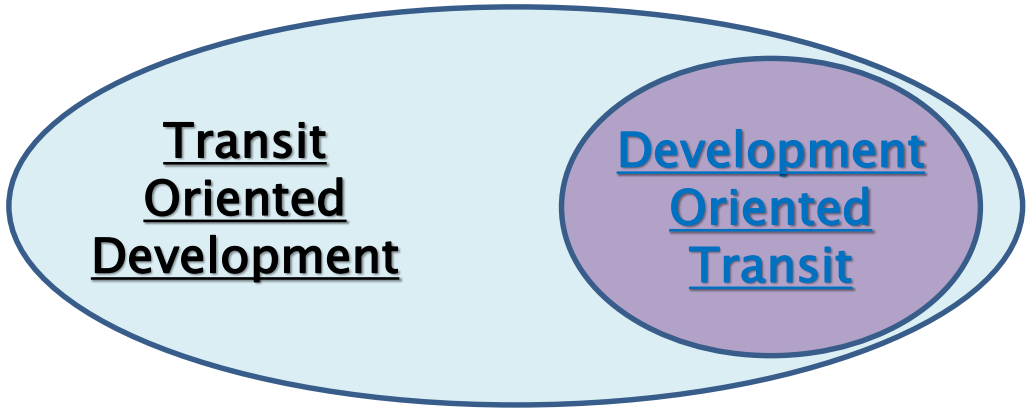


Development Oriented Transit



In Development Oriented Transit, the alignment of transit will be decided considering the opportunities of TOD, which means you can select an alignment with better opportunities for TOD. **Does your feasibility study of the transit include TOD opportunity as one of the criteria?**

Is it TOD or DOT?



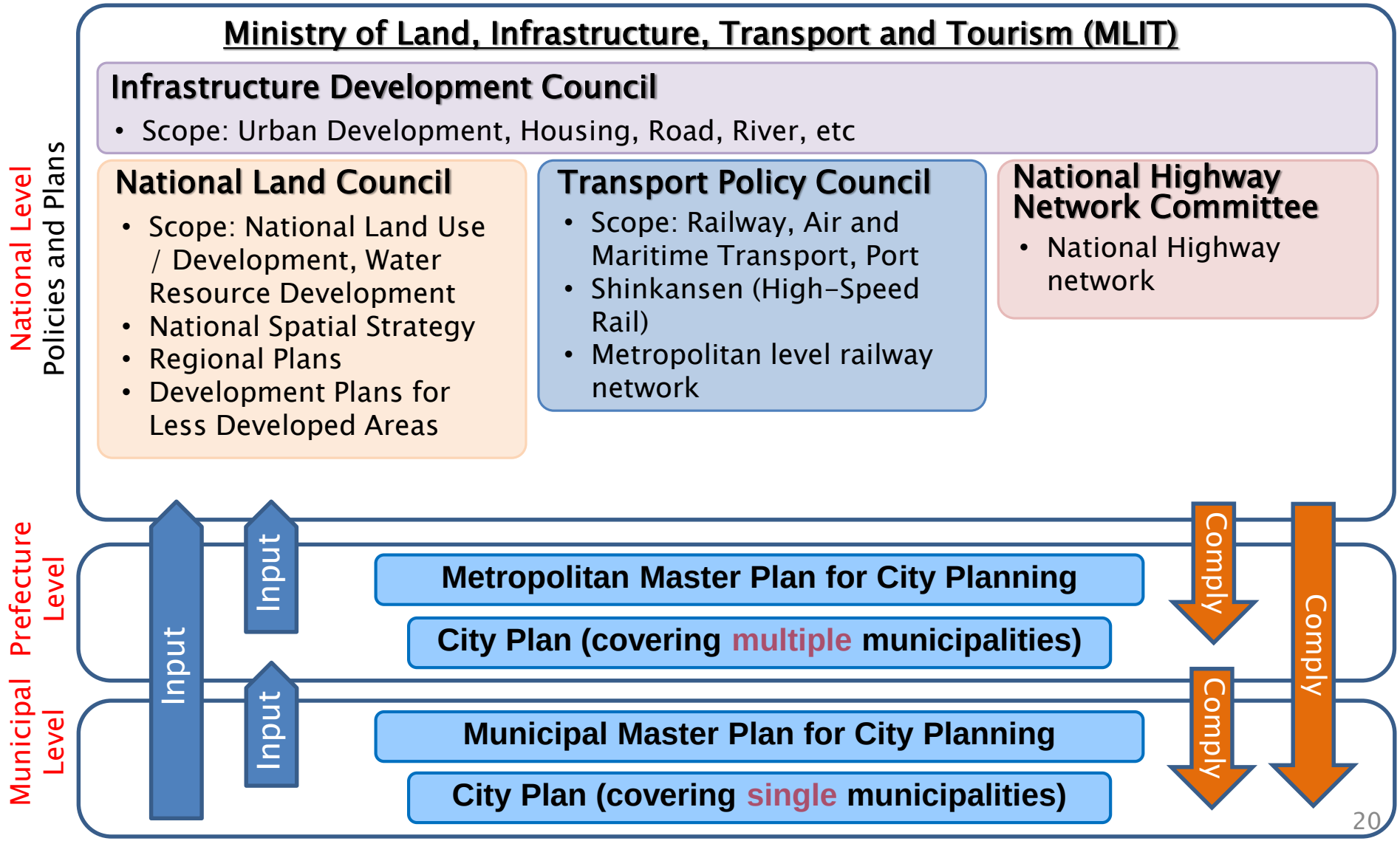
Scope of TOD Interventions:	Limited/Flexible	**Flexible**
Scale of TOD Interventions:	Small to Large	**Large**
Planning Timeframe:	Short/Medium/Long term	**Long term**
Planning Perspective:	Station area to Regional	**Regional**
Planning Coordination:	Minimal/Complete	**Complete**

Chapter 3

FRAMEWORK FOR TOD PLANNING AND IMPLEMENTATION IN JAPAN

3. Framework: Overview of planning framework

Coordinated plans in different levels govern the development and conservation of national land.



Coordination takes place through drafting of City Plan

Composition of City Plan

Land Use

1. Area Division (Area to promote or control urbanization)

2. Zoning
- Land Use Zone
- Special District
- Height Control Dist. etc

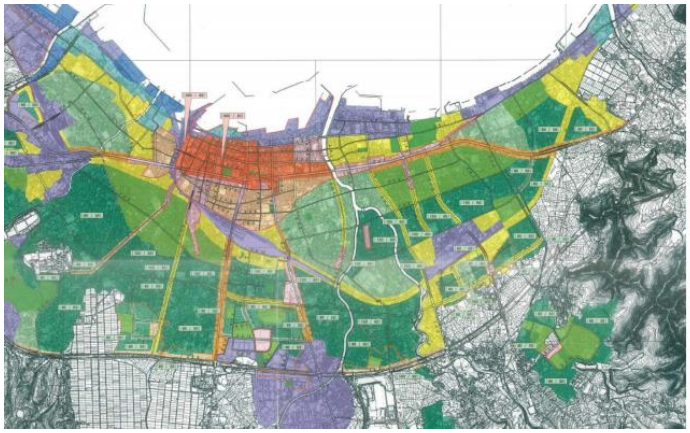
3. District Plan (Detailed Plan on land use, FAR, set-back, preservation, infrastructure, material, height etc.)

Infrastructure/Facility

- Road, Railway, Parking, Terminal
- Park, Green space, Cemetery
- Sewerage, Water supply, Treatment plant
- River, Waterway
- School, Library
- Hospital, Daycare
- Market, Slaughterhouse
- Apartment
- Government office

Development Project

- Land Readjustment
- Newtown Development
- Urban Redevelopment
- Industrial Park Development



Process to create/modify City Plan

Public hearing, community workshop etc.

Preparation of the draft plan

Public announcement

Public exhibition of draft

Submission of written opinion by concerned resident/party

Deliberation by **City Planning Council**

Approval by higher authority (if necessary)

Announcement of Determination

City Planning Council is a review panel set up by local government that gives an independent review of the proposal and submitted opinions.

(Example) Kunitachi City's Council includes academics (<4), city assembly member (<5), representative from relevant government agency (<1), and residents (<3).

3. Framework: City planning framework

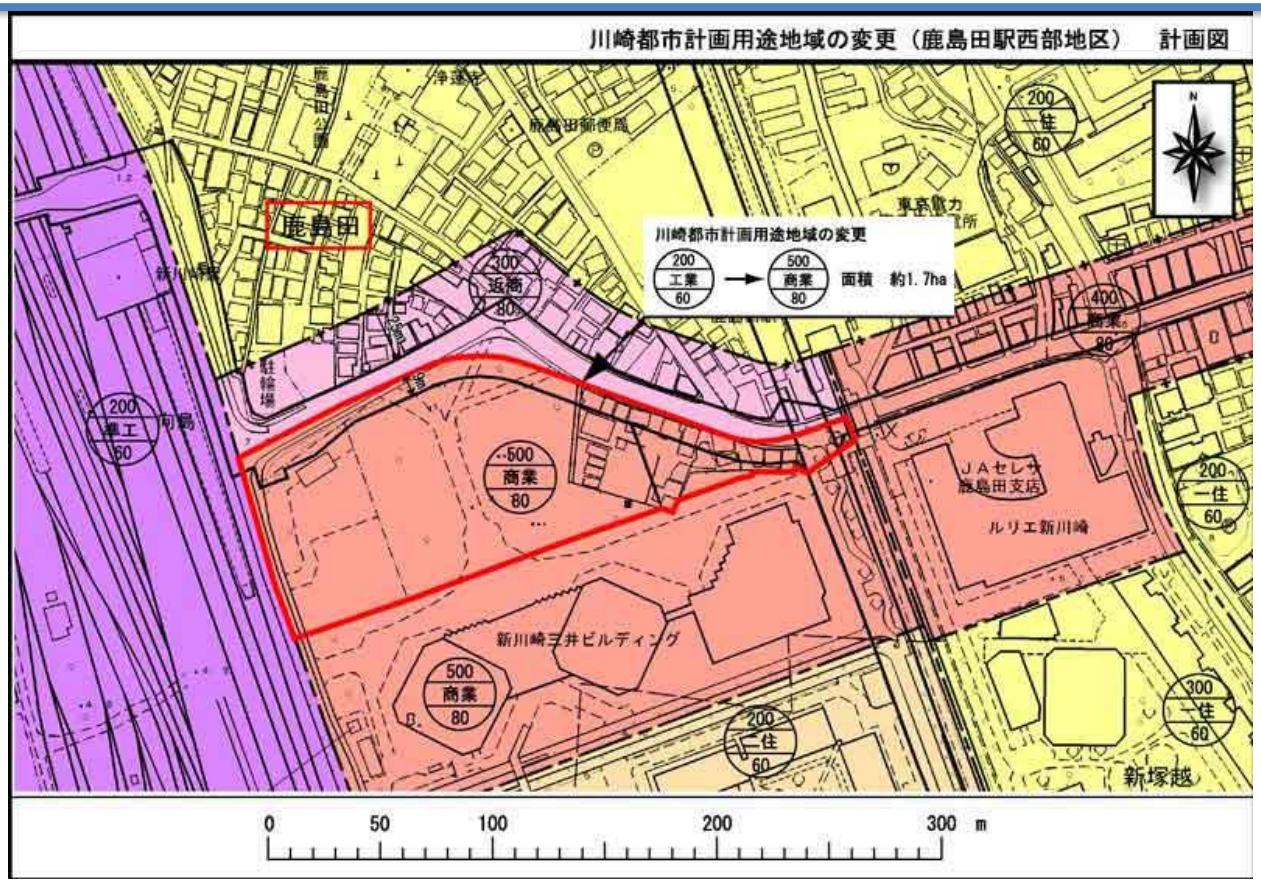
Once decided on City Plan, alterations to the shape and quality of land, and construction of buildings are restricted.

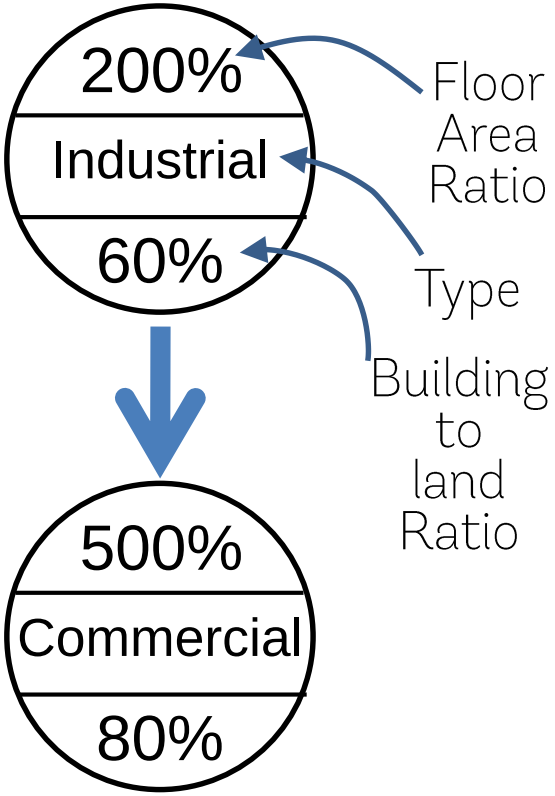
http://www.city.yokohama.lg.jp/doro/plan/minaoshi/kouhorosen/3453shinyoshinaka/

This new road #3.4.53 to access Tsuzuki Exit of the 3rd Keihin Expressway is proposed to reduce congestion of existing access roads. Once decided to be included in the City Plan, building activities on the land within the boundary of #3.4.53 are restricted.

3. Framework: City planning framework

Once decided on City Plan, alterations to the shape and quality of land, and construction of buildings are restricted.





http://www.city.kawasaki.jp/500/page/0000003426.html

This under-utilized land near Kashimada Station on a JR line was being included in the separately-proposed urban redevelopment project. To enable conversion of land use and high density, the zoning change was proposed for City Plan. Once the change is decided, industrial land use is prohibited, while commercial land use is permitted.

3. Framework: City planning framework

Rule: Higher FAR can be given if the area is close to stations with higher passenger use. FAR is a part of City Plan.

Applicable Base FARs For Commercial Zone in Tokyo:

#	Characteristics of the area	Distance from Center	FAR
1	Areas not appropriate for high density use	All	200- 300%
2	Areas appropriate for high density use	All	400%
3	Outside Circular Road #7, facing 20+m wide road	>10km radius	400- 500%
4	Inside Circular Road #7, facing 20+m wide road	<20km radius	500- 600%
5	Near stations with 5M - 16M passenger use / yr	All	200-500%
6	Near stations with 16+M passenger use / yr	All	500-700%
7	Forming a Core area, through area development	>20km radius	700-800%
8	In center. Core of Sub-Center or a new Core. Through area development or facing 25+m wide road.	<10km radius	600-900%
9	In center. High level of infra available, such as surrounded by 4+ lane arterials or stations with multiple rail lines.	<10km radius	1000-1300%
10	Near center, or Core of Sub-Center. For commercial area with large catchment, or facing 20+m road.	<10km radius	500-700%

Source: Tokyo Metropolitan Government, 2002, Policy and Criteria for Determining Land Use Zones

3. Framework: Development Project Schemes

Three key project schemes are available to realize City Plan .

1. New Urban Residential Area Development Project

- Objective: To develop good-quality urban residential area and provide substantial scale of residential land in areas with high demand for residence
- Enacted: 1963 (1 project in Tokyo (2,217 ha))
- Modality: All land in the project area will be acquired to be developed and sold.

2. Land Readjustment Project

- Objective: To develop good-quality urban area
- Enacted: 1954 (633 projects in Tokyo (23,000 ha))
- Modality: All land plots in the project area will be readjusted and returned back to the original owner after taking out 'contribution' for infrastructure land and reserved land to fund project cost.

3.Urban Redevelopment Project

- Objective: To promote reasonable and sound high density use and renew urban functions
- Enacted: 1969 (183 projects in Tokyo (463 ha))
- Modality: All land plots in the project area will be converted to ownership of a floor area of redevelopment building and a share of joint ownership of land.

Data as of March 2010. http://www.toshiseibi.metro.tokyo.jp/bosai/tokyoseibi.pdf

3. Framework: Development Project Schemes

New Urban Residential Area Development Project supported new town development mainly in 1960s and 70s.

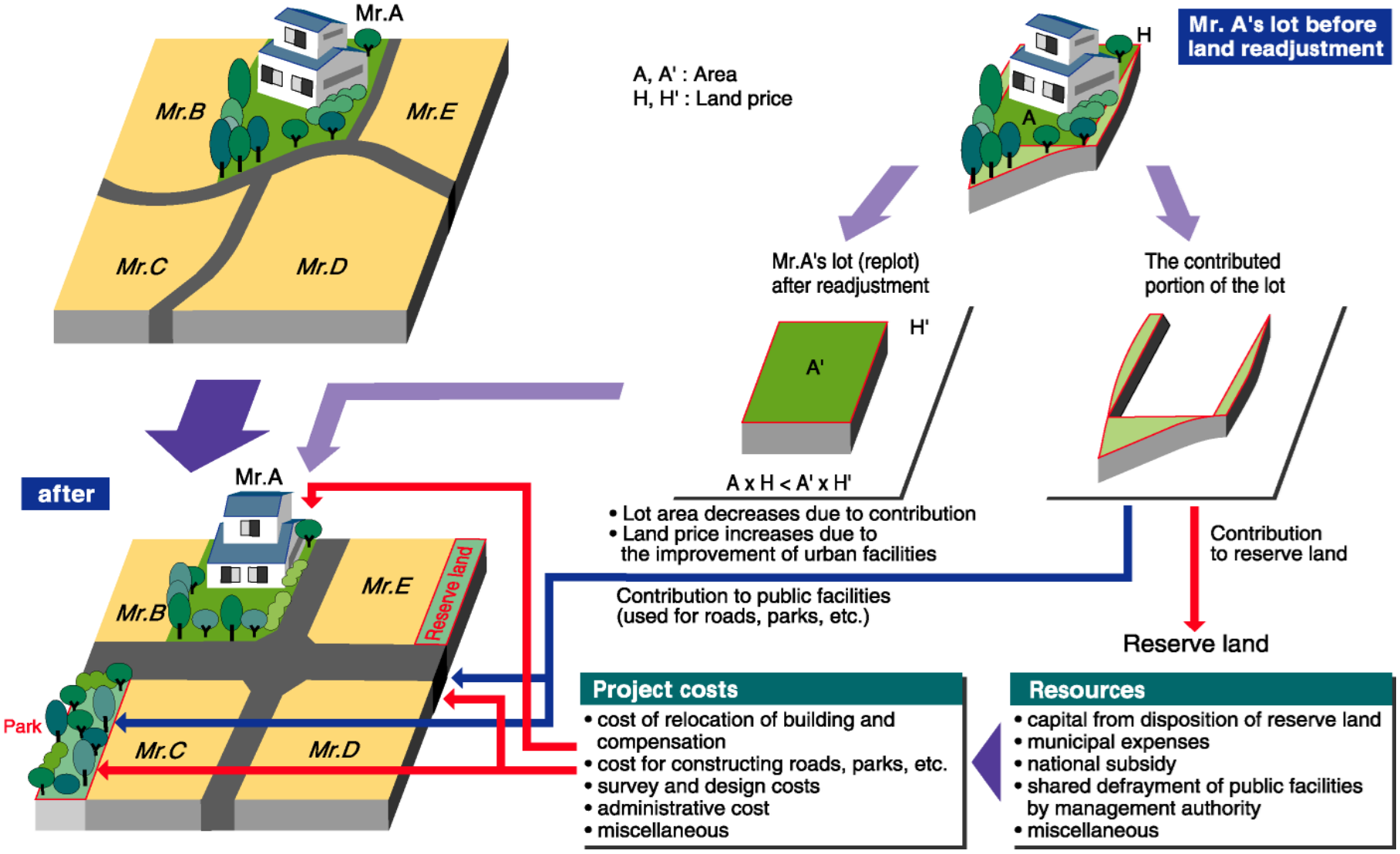
Summary of New Urban Residential Area Development Projects

	Cities	Projects	Total Area (ha)	Planned Population (thousands)
Hokkaido	9	9	1,758.2	180.1
Tohoku	2	3	367.0	43.0
Kanto (incl. Tokyo)	14	8	5,230.8	542.4
Hokuriku	1	1	226.1	16.0
Chubu	1	1	321.5	40.0
Kinki (incl. Osaka)	10	19	6,675.0	735.4
Chugoku	4	5	666.4	62.2
Shikoku	-	-	-	-
Kyusyu	4	5	674.3	67.5
Okinawa	-	-	-	-
Total	**45**	**51**	**15,919**	**1,687**

The largest was Tama New Town of 2,217 ha for 282,000 planned population. Projects can be implemented by Prefectures, Municipalities, Housing Supply Public Corporations, and Urban Renaissance Agency (UR).

3. Framework: Development Project Schemes

Land owners receive smaller land in better shape and with infrastructure, making the land value the same or more.



3. Framework: Development Project Schemes

LR is definitely the instrumental project scheme that help formed cities in Japan, including Tokyo.

Developed about 1/3 of all urban area in Japan
(1/4 of area in Tokyo's Wards developed through LR)

Developed about 1/2 of all principal residential parks in Japan (Parks amount to 14,000 ha)

Developed about 1/4 of roads designated in City Plans (Roads amount to 11,000 km)

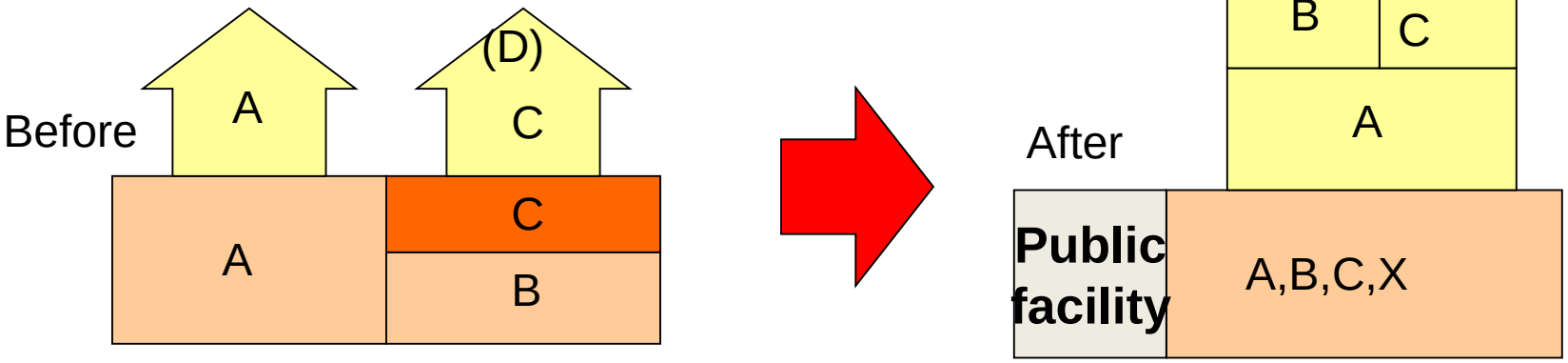
Developed about 1/3 of station plazas at major train stations* in Japan (About 900 station plazas)

* Stations with more than 3,000 passengers per day

3. Framework: Development Project Schemes

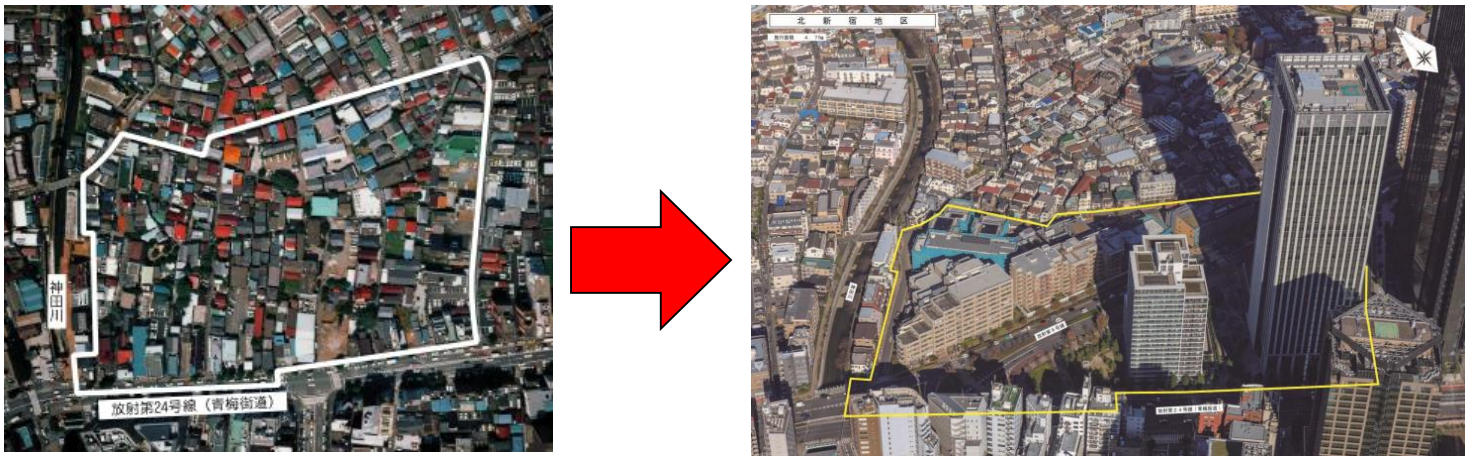
Urban Redevelopment Project effectively redevelops built-up areas that are unsafe and having insufficient infrastructure.

Land Ownership
Land Leasehold / Superficies
Building Ownership / Floor Ownership
Reserved Floor for Sale



Kita-Shinjuku Project

- 1998-2016
- 4.7ha
- Tokyo Metropolitan Government



http://www.toshiseibi.metro.tokyo.jp/bosai/sai_kai-kitasinjuku.pdf

Chapter 4

CASE STUDIES

TOD PLANNING AND IMPLEMENTATION

4. Case Studies: New Town Development by government and private railways

New Urban Residential Area Development Project supported new town development mainly in 1960s and 70s.

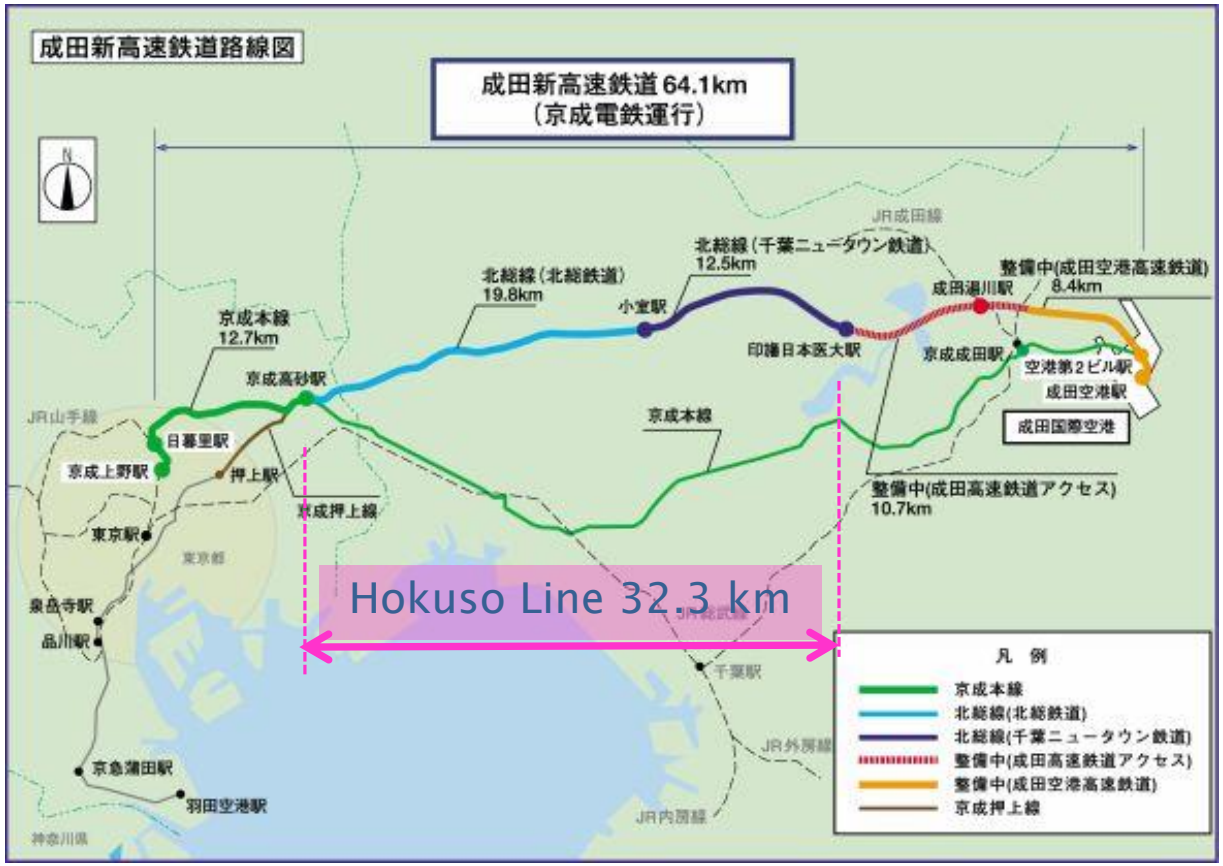
Planned at 25-40km northeast of Tokyo towards Narita Airport, **Chiba New Town** was built through the New Urban Residential Area Development Project scheme. The project area was 1,930ha for a planned population of 143,300. Started in 1969 and completed in 2014. Project cost was JPY 1190.3 Billion (USD 11B).

https://www.pref.chiba.lg.jp/kigyou/nt/documents/h27-2-cnt-front.pdf

https://www.pref.chiba.lg.jp/kigyou/nt/documents/keikakuzuall2.pdf

4. Case Studies: New Town Development by government and private railways

Hokuso line was established jointly by Keisei Railway and public entities.

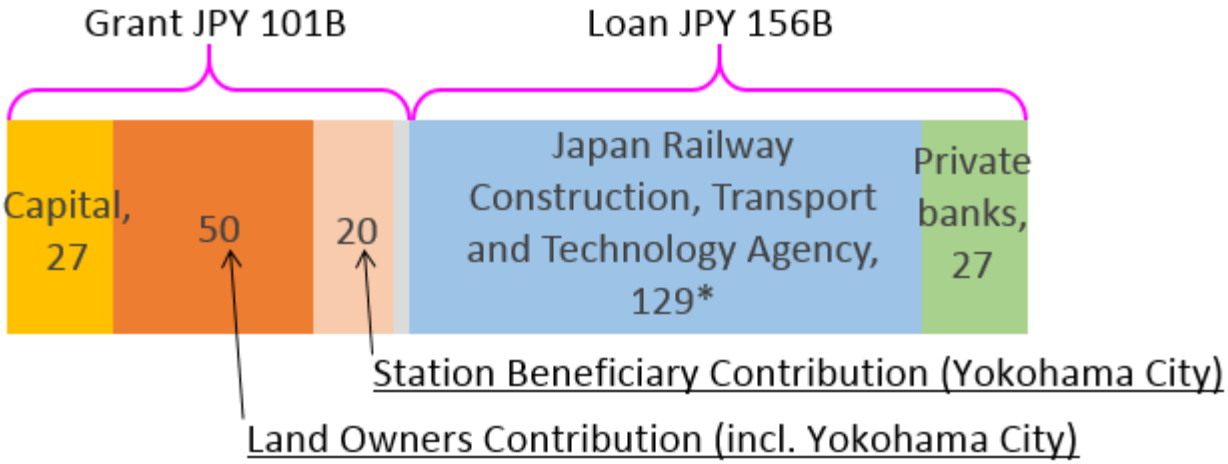


- A 32.3 km section on a new line connecting Narita Airport and Keisei Ueno terminal.
- Hokuso Railway was established by:
  - Keisei Railway (50.0%)
  - Chiba Pref (22.3%)
  - Urban Renaissance Agency (UR) (17.3%)
  - Matsudo City (1.4%)
  - Shiroi City (1.0%)
- Due to the delay of the Chiba New Town development, the railway has suffered from low ridership.

4. Case Studies: Joint Development of Business Core City and Railway

National and local governments, and other beneficiaries contributed to the construction of new subway.

Minato Mirai Line Subway (Yokohama)



* For the repayment to JRTT, interest payment exceeding 5% rate will be borne by local and national government.

- A 4.1km new underground line connected directly with Tokyu Toyoko line.
- Construction cost was JPY 257B (USD 2.4B).
- Opened in 2004.
- Owned and operated by Yokohama High Speed Rail, which Yokohama City holds 63% share along with other public and private entities.

4. Case Studies: New town development by private railways

Tama Garden City Development is a half-century LR project of 5,000 ha forming the passenger base of Tokyu's railway.

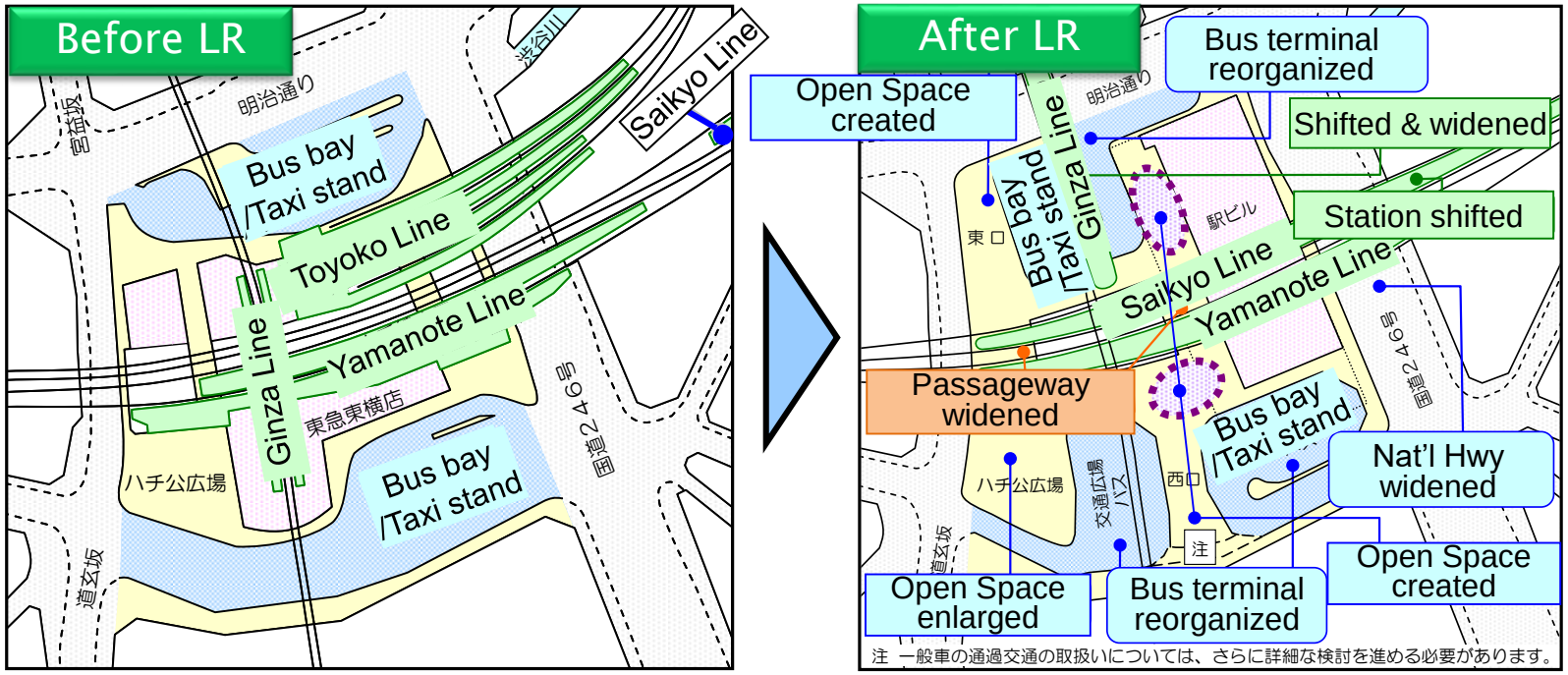
Tokyu Tama Garden City Line and Garden City Development (5,000ha)

The development is located 15 to 35 km to the south west of downtown Tokyo and was undertaken while Tokyo went through rapid urbanization. The projects were done mostly through Land Readjustment project scheme.

4. Case Studies: Shibuya – Complex, requiring through coordination

At Shibuya, along with the shifting of railway stations, various measures to improve station access will be undertaken.

Shibuya Station Land Readjustment Project



http://bluestyle.livedoor.biz/archives/51841997.html

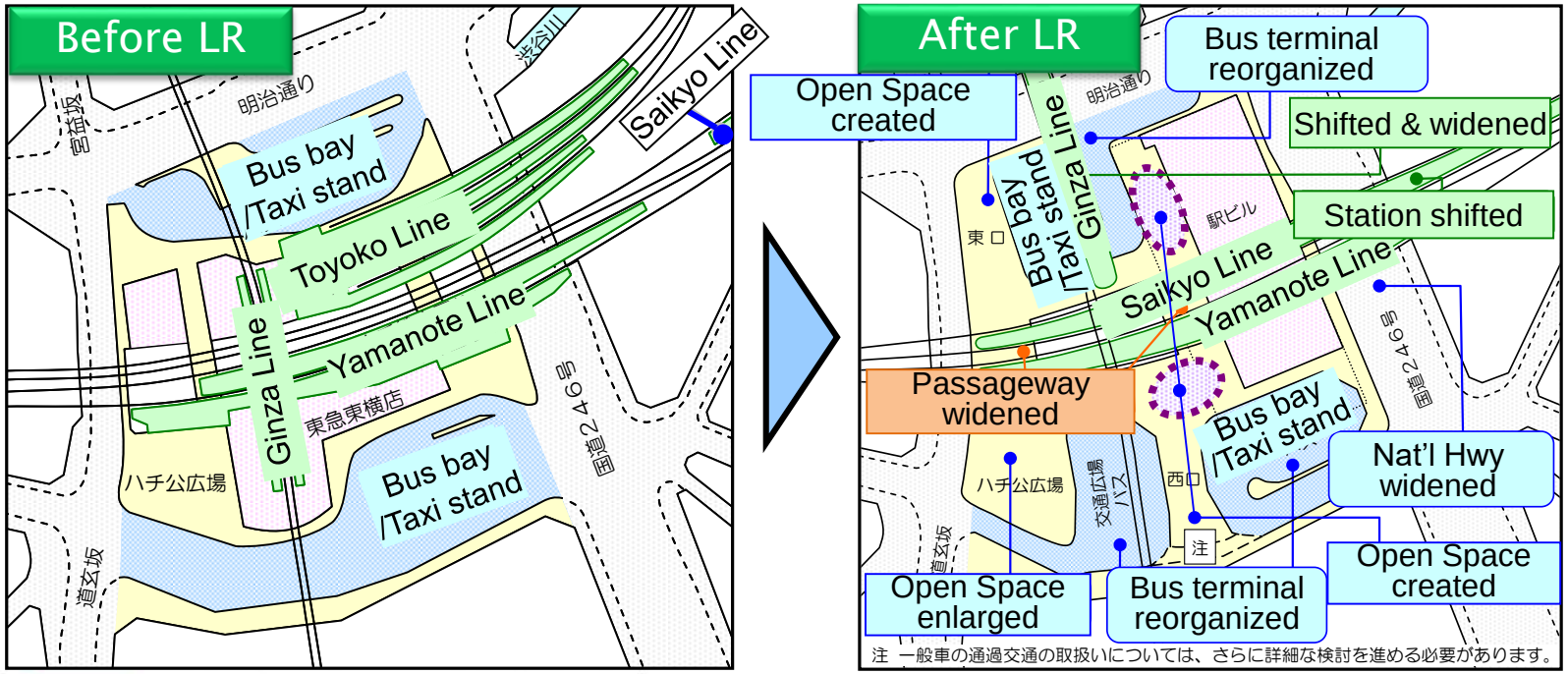
Source: Wikipedia

http://tekkenweb.sakura.ne.jp/railways/y2008/rfukutoshin001.html

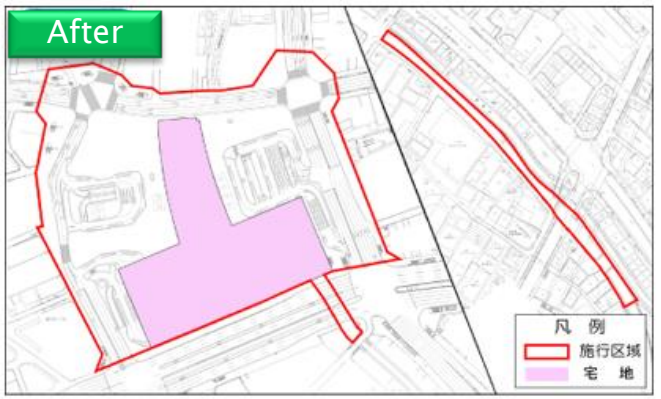
4. Case Studies: Shibuya – Complex, requiring through coordination

Replotting of land through LR enables better efficient land use and proper infrastructure planning.

Shibuya Station Land Readjustment Project



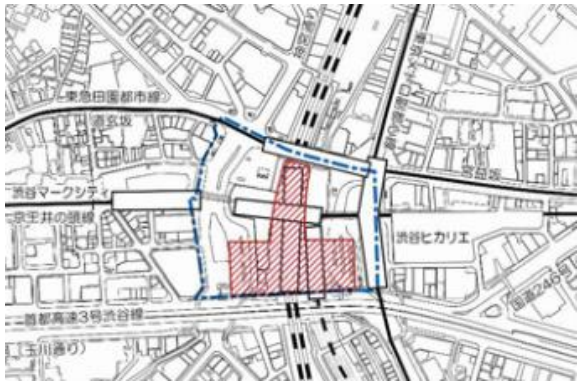
Private land ( ) will be shifted and reshaped



4. Case Studies: Shibuya – Complex, requiring through coordination

For Shibuya Redevelopment Project, various City Plan components needed modified and approved.

City Plan Components	Content	Year Approved
Land Use		
Urban Renewal Spec. Dist.	FAR 1,560%, H<230m	2013
District Detailed Plan	Detailed use, Ped. walkway	2013
Infrastructure		
Road	w=21m	2009, 2013
Station Plaza	17,400m2+1,300m2	2009, 2013
Parking	9,500m2	2013
Railway	Shifting Ginza Line station	2009
River	2,270m	2009
Development Project		
Land Readjustment	5.5ha	2009
Urban Redevelopment	0.6 ha (across street fr station)	2013



Source: Tokyu Corp.

Private sector developers (incl. railways) wanting
- Higher FAR
- Infrastructure improved

Negotiation takes place targeted for agreement on the draft City Plan

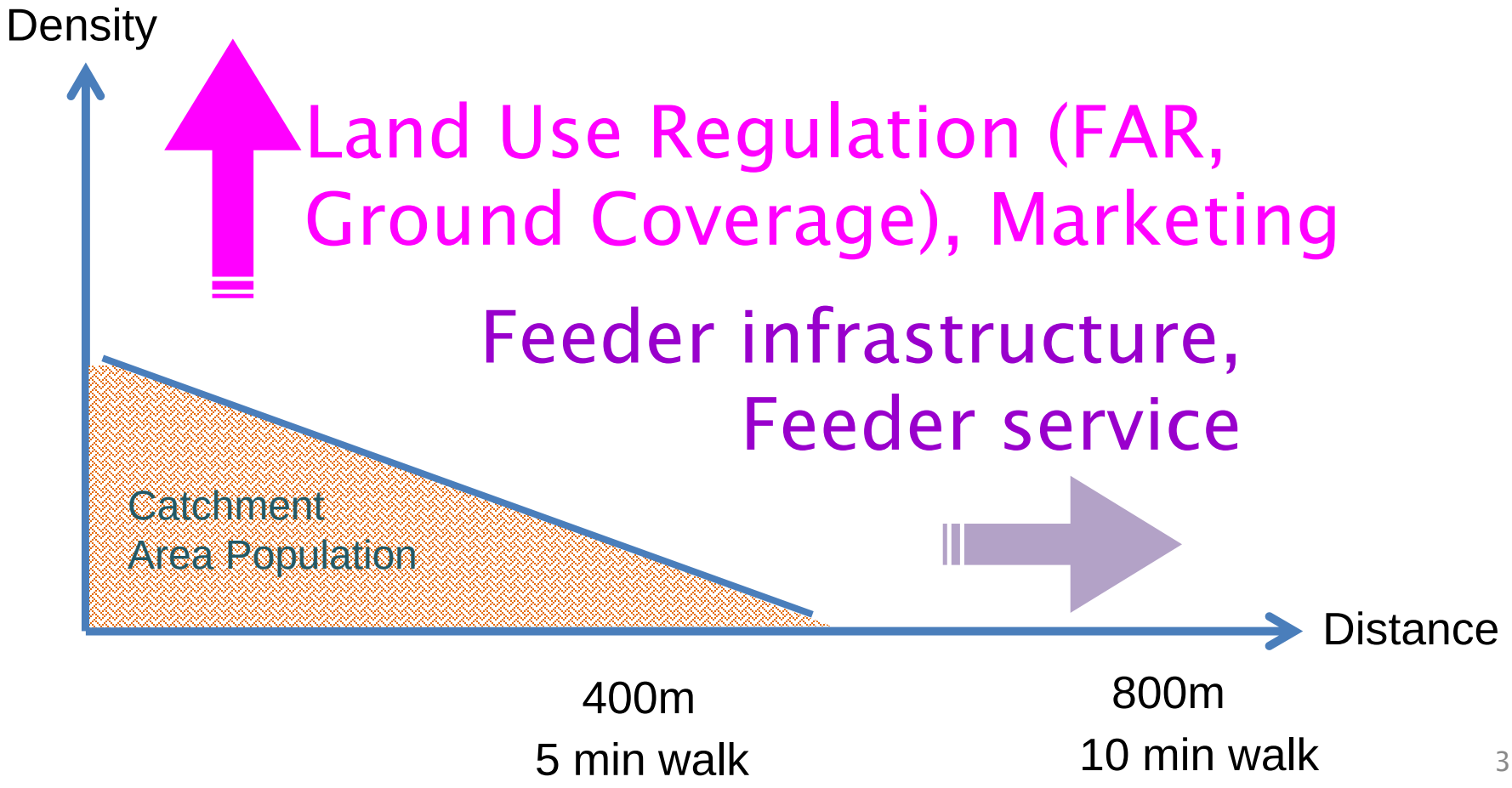
Government wanting
- Revitalizing the core areas
- Improving station access
- Enhanced disaster resilience
- Infrastructure funded by the private.

Chapter 5

ACCESS IMPROVEMENT FOR TOD

5. Access Improvement: Measures to increase station catchment

What determines the catchment population in the transit-shed?

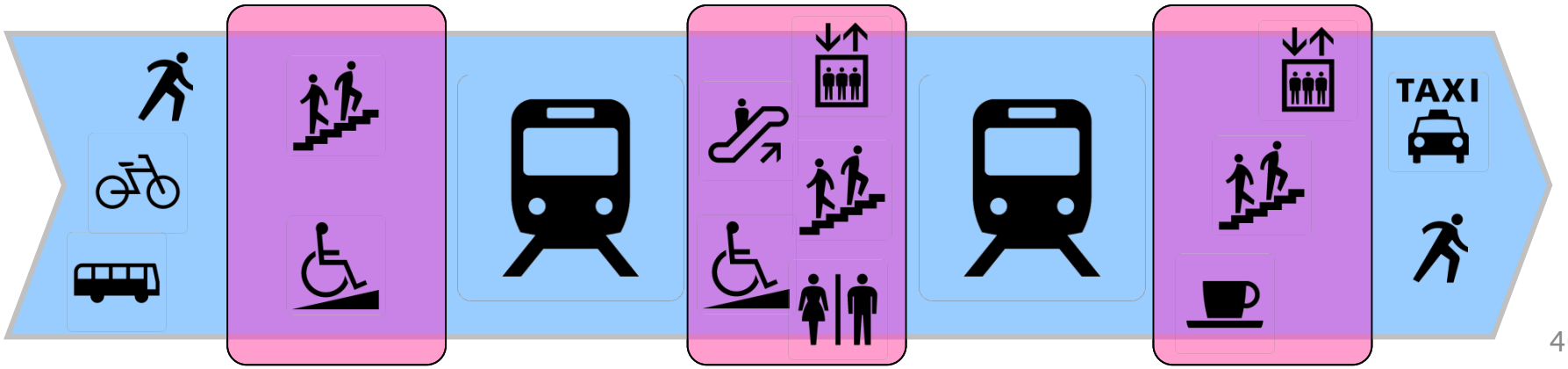


5. Access Improvement: Integration of Modes

Improvement of the connectivity at station affects the mode choice in various ways.

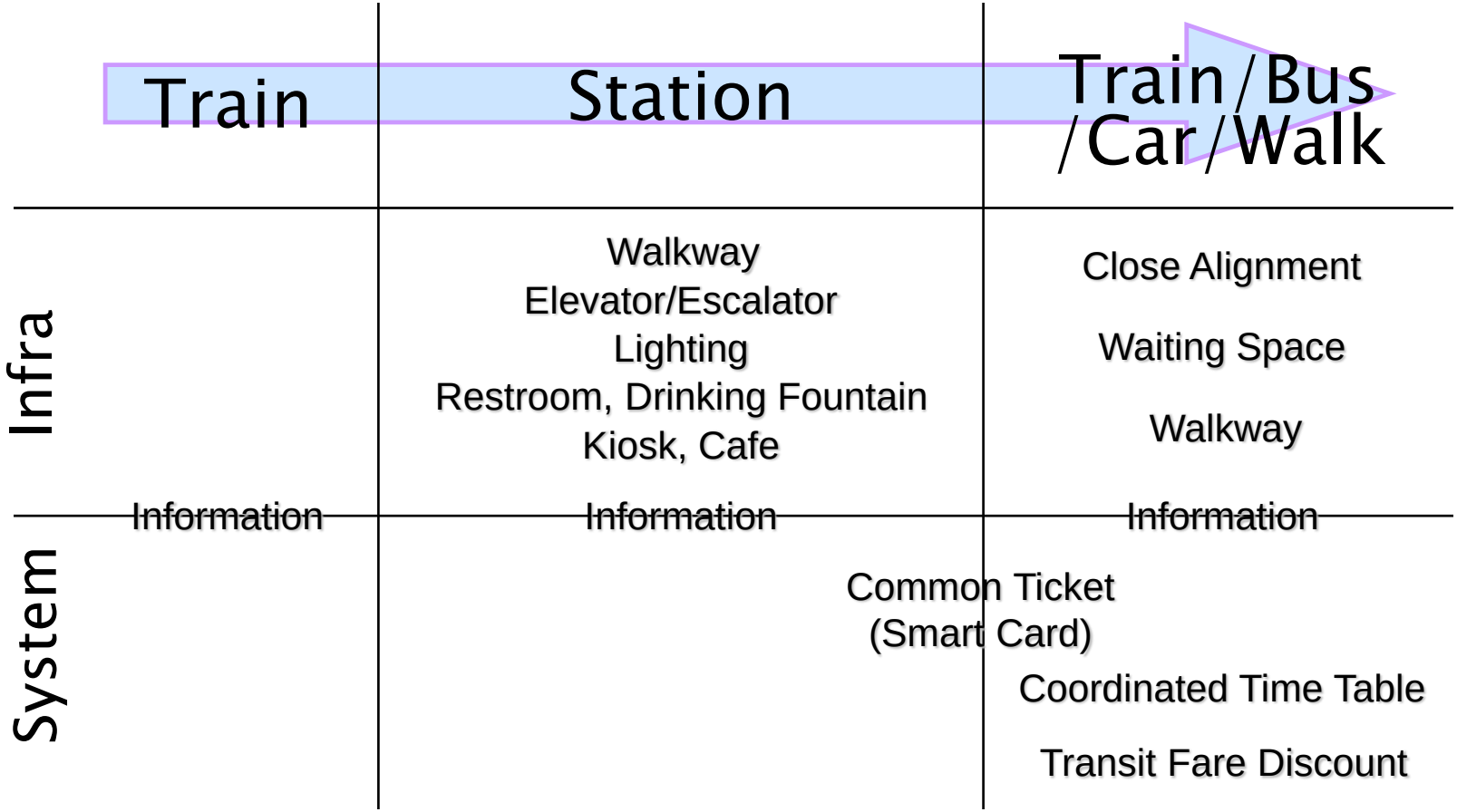
Factors affecting mode choice

1. Factors dependent on **Trip Maker**
    a. Availability of personal vehicle (& parking) / public transport
    b. Need to use car at work or on the way (carry heavy thing, pick-up)
2. Factors dependent on **Transportation Mode**
    a. Travel time (including waiting and transferring)
    b. Financial cost (fares, parking fee, expressway, fuel)
    c. Comfort level (seat availability, walking up and down, cleanliness)
    d. Convenience (want to read, sleep, view)
    e. Reliability (timetable, probability of delays)
    f. Safety and Security



5. Access Improvement: Integration of Modes

Connectivity between modes can be improved both in infrastructure and system design domains.



5. Access Improvement: Integration of Modes

Better informed passengers can interchange more smoothly.

Passenger Information Service Examples

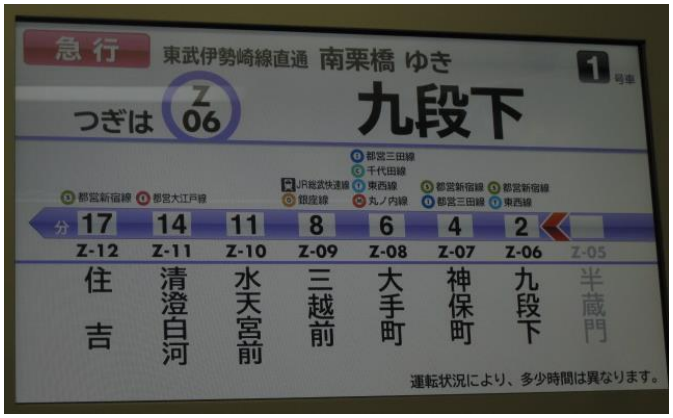
- Route Map
- Timetable
- Display Panel
- Sign, Marking
- Color Coding/Numbering
- Announcement
- Station clerk
- Internet

Station Sign Board

Vicinity Map

Points of interests and Street Address and corresponding exits

In-train Monitor Screen



Showing next stations, connecting lines, and expected travel time.

Showing the locations of stairs and elevators leading to exits and connecting lines at next station.

5. Access Improvement: Integration of Modes

Securing access for elderly and disabled passengers is not only a social responsibility but also a legal obligation for railway.

Transportation Accessibility Improvement Act (2000)

The law introduced an requirement for public transport operators to secure accessibility of the elderly and disabled. Now that 90% of 2,800 stations with 5,000+ daily passengers have elevators, a new target has been set to achieve the same for 3,000+ stations by 2020.

Elevator

Escalator

Bumpy warning tiles in bright yellow to guide blind passengers safely.

Space for wheelchairs on train.

"Platform Doors" to prevent passengers on platform from falling or hitting.

Tokyo Metro's 78 out of 179 stations have "Multi Function Restroom."

Source: Tokyo Metro

5. Access Improvement: Integration of Modes

By effectively combining these facilities, connectivity improvement can be achieved.

Station plaza

Accommodates bus stops, taxi stands, kiss and ride spots, open space and other facilities for passenger convenience.

Walkway over the track

Connects two sides of station making smoother pedestrian and car traffic.

Walkway over station plaza/ road

Separates pedestrian flow from car traffic to safely reach their destinations.

Off-street parking

Enables passengers to park cars and bicycles without occupying road space.

5. Access Improvement: Integration of Modes

A station plaza is a key facility in expanding TOD catchment area by facilitating smooth transit between different modes.

Source: JR West

Source: Tokyu Corp.

As per MOU between the Ministry and JR companies, JRs will provide 1/6 of the land area for the station plazas, while the rest is born by the local government.

5. Access Improvement: Integration of Modes

With the parking demand and active enforcement, designated bike parking is a MUST at railway stations in Japan.

Illegal bike parking

<Bicycle Act>

Local government shall make efforts to provide public bike parking where necessary.

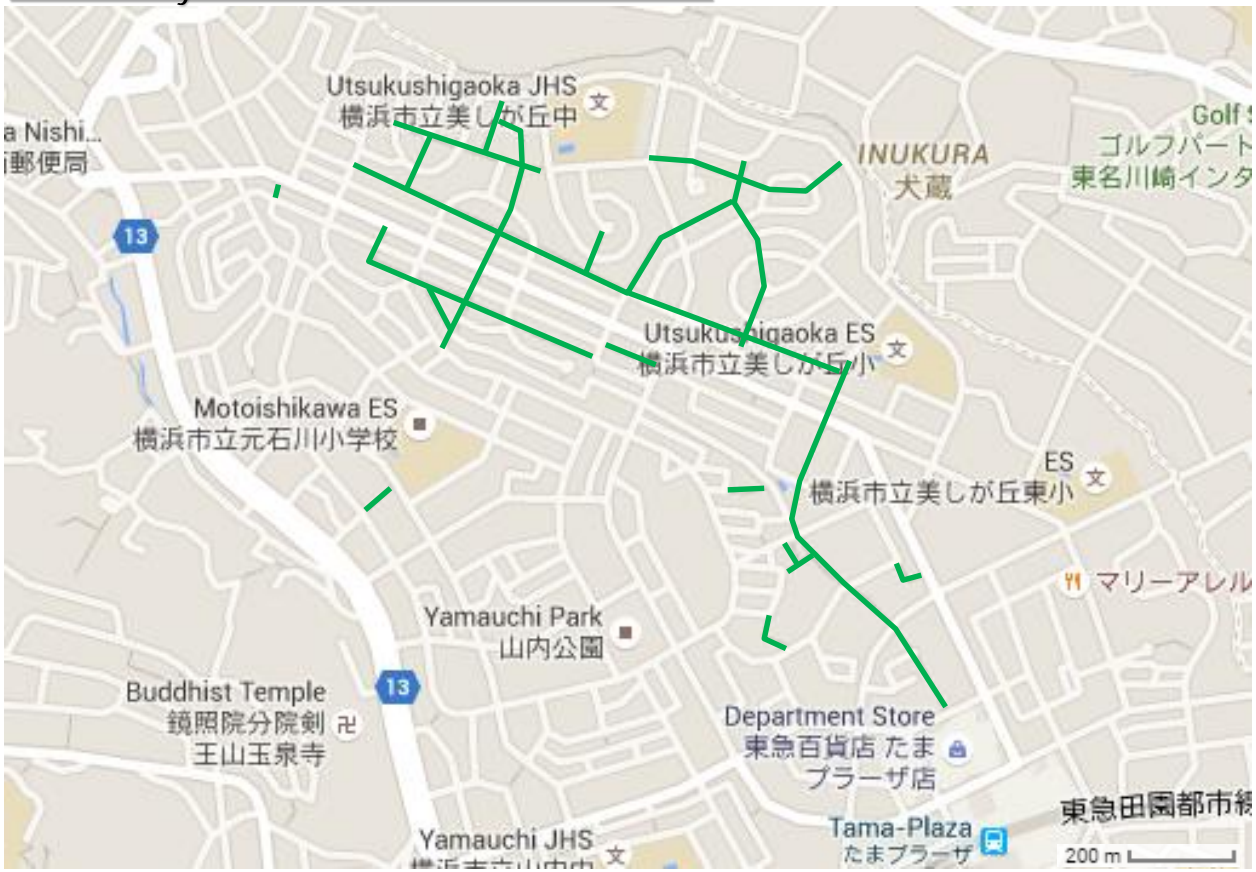
Railways shall proactively cooperate with local government through transfer or lease of land, or any other means.

Public bike parking

5. Access Improvement: Feeder network to enlarge station catchment

Tama Plaza development area has a vast network of roads only for pedestrians and bicycles.

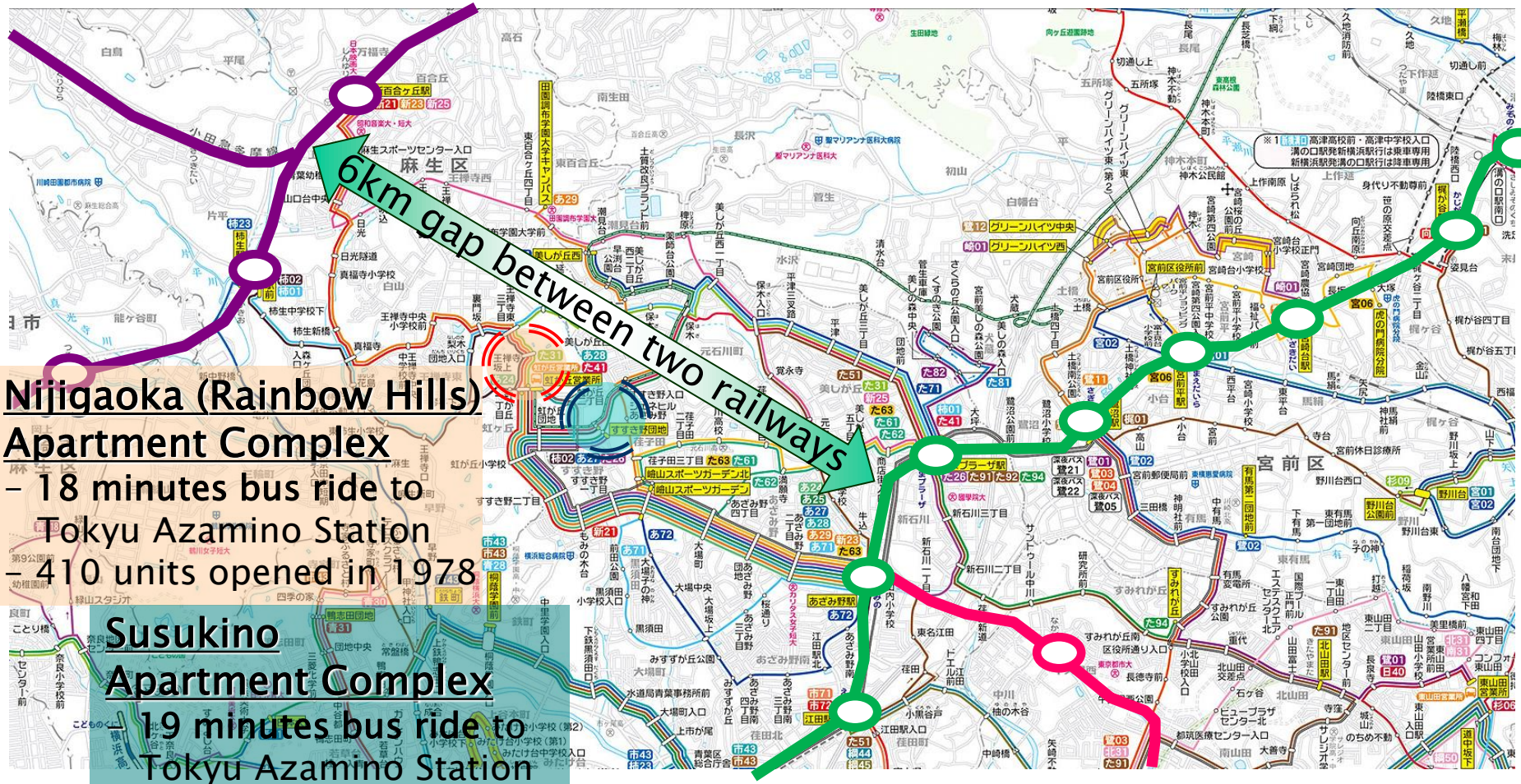
Walkway network in Tama-Plaza.



- While bus serves those not in the area close to station, walking and bicycle are the major access modes for those in the station vicinity.
- **Walkway network extends as far as 2km from the station** and the station also has bicycle and motorcycle parking spaces.

5. Access Improvement: Feeder network to enlarge station catchment

The feeder bus service increases the value of gap land between railways, which otherwise is unpopular to commuters.



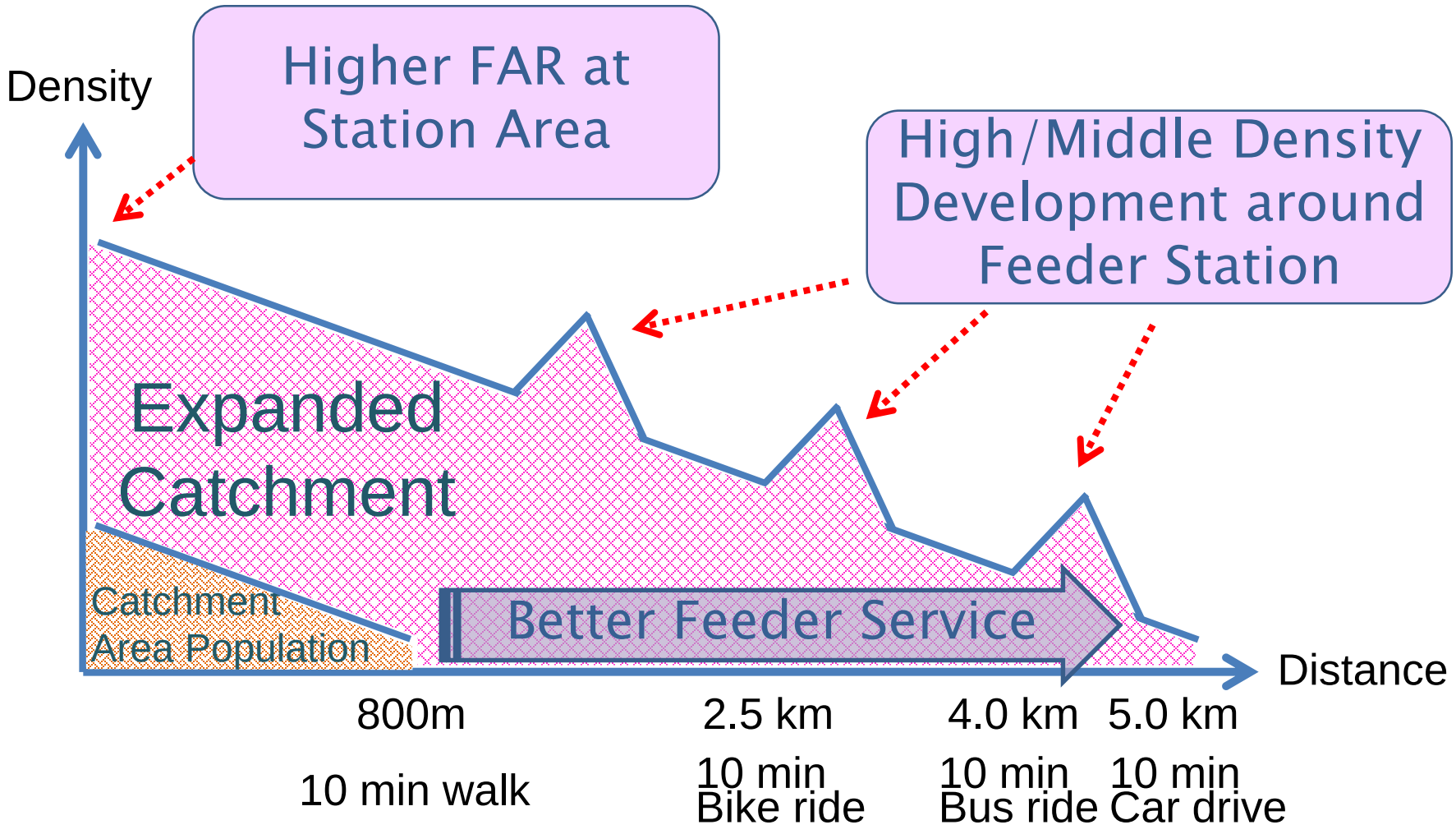
Nijigaoka (Rainbow Hills) Apartment Complex
- 18 minutes bus ride to Tokyu Azamino Station
- 410 units opened in 1978

Susukino Apartment Complex
- 19 minutes bus ride to Tokyu Azamino Station
- 1940 units in 1974-80

Map: Tokyu Bus Corp. Web

5. Access Improvement: Measures to increase station catchment

Higher FAR, high/middle density development remote from station, and better feeder increase station catchment.



Chapter 6

CONCLUSION

5. Conclusion

Takeaways from Japan's experience on TOD planning and implementation.

1. **Coordination between land use and transit takes place at various levels.** From policy level at the councils at the Ministry, to Capital Region Development Plan for the regional perspective, and then to City Plan at detailed level. The binding nature of the decisions is important.

2. **Depending on the type of TOD, different implementation schemes have been utilized.** While large-scale Development Oriented Transit projects relied on full acquisition scheme, Land Readjustment has been vastly used, giving flexibility in infrastructure design and opportunity to recoup spilled benefit.

3. **Station access improvement is an integral part of TOD.** Through information provision to feeder NMT and bus networks, improved access leads to expanded catchment population.

Thank you.

ssakaki@worldbank.org

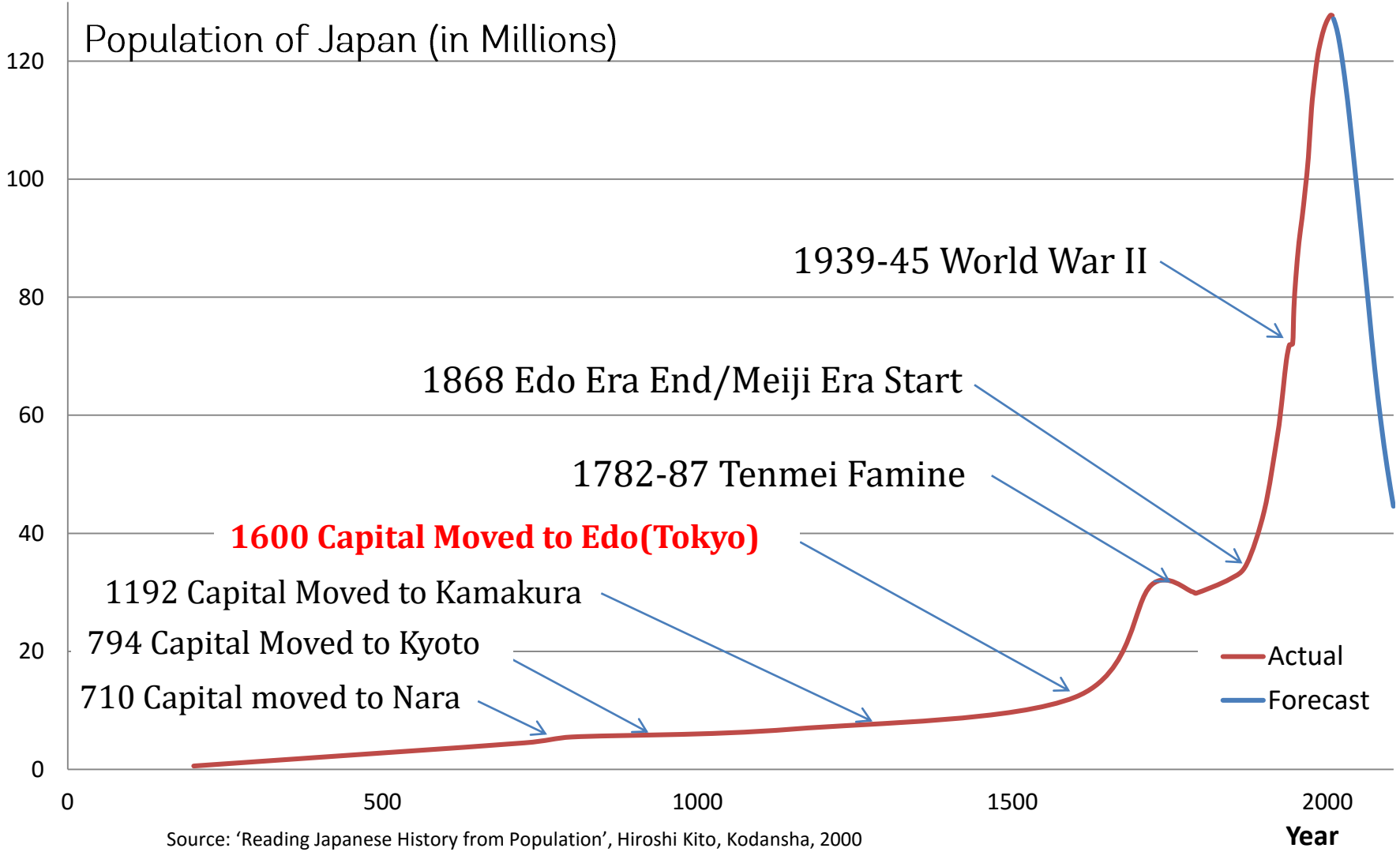
Annex:

URBAN DEVELOPMENT HISTORY

– HOW TOKYO HAS EVOLVED TO ITS CURRENT STRUCTURE?

2. History: Overview

Tokyo is relatively a new city internationally, becoming the capital in 1600.

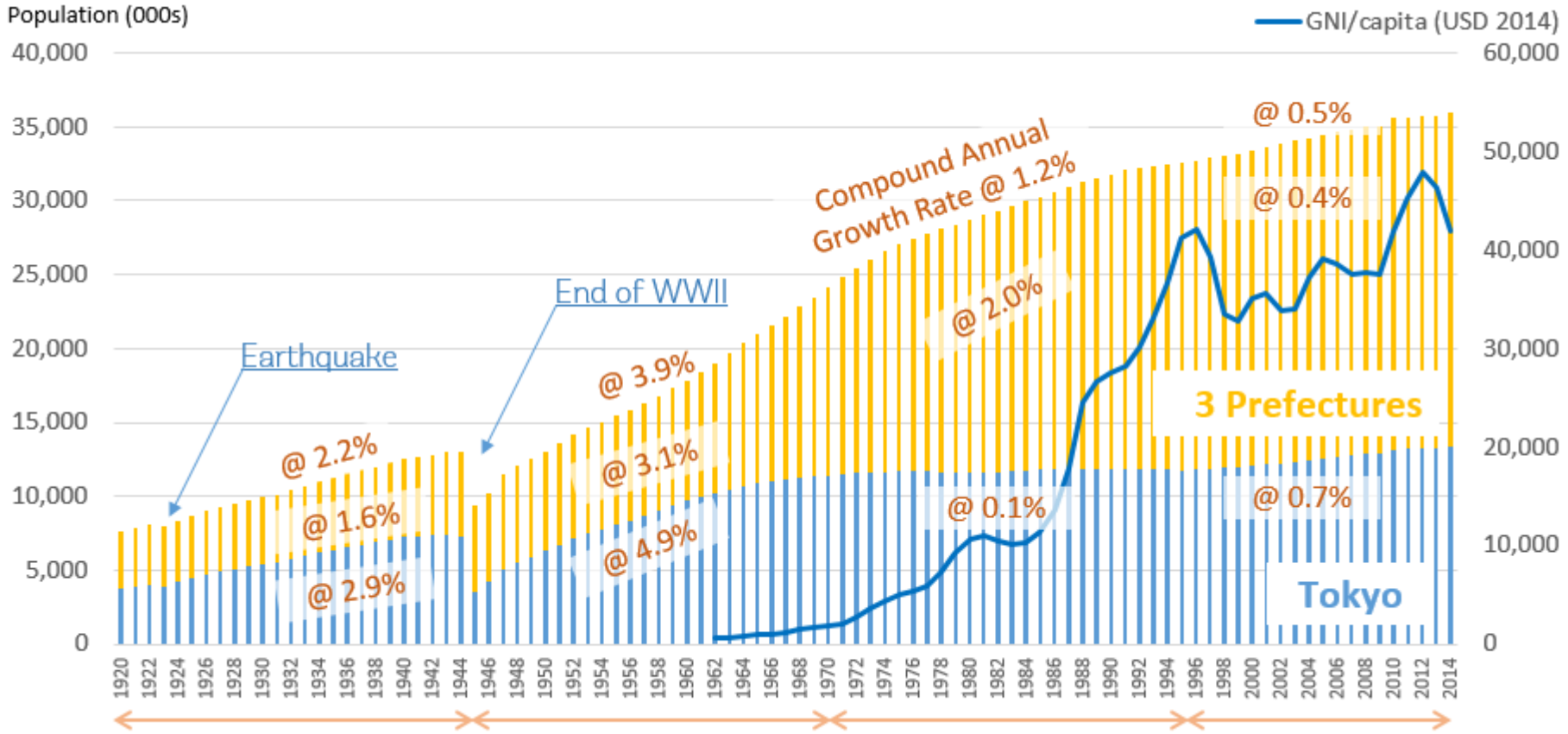


Source: 'Reading Japanese History from Population', Hiroshi Kito, Kodansha, 2000
'Population Census', Ministry of Internal Affairs and Communications,
'Population Forecast of Japan', National Institute of Population and Social Security Research, 2006

2. History: Population growth in Tokyo Region

Rapid expansion took place first before WWII, and then in 50s and 60s. Tokyo stabilized since, but the suburbs continued.

Population of Tokyo and 3 surrounding prefectures



2. History: Great Kanto Earthquake (1923)

While urban planning legislation was enacted in 1888, the earthquake was the first trigger to modernize legacy districts.

- The Magnitude 7.9 earthquake happened on September 1, 1923, right at the time people prepared lunch. The fire from cooking stoves quickly spread and burned down 450,000 buildings, killing 140,000 people.
- Reconstruction projects included: Land Readjustment (LR) projects for 3,119ha; arterial roads including Showa and Yasukuni Streets; parks; public apartments; bridges on Sumida River.

[Ginza,Tokyo]

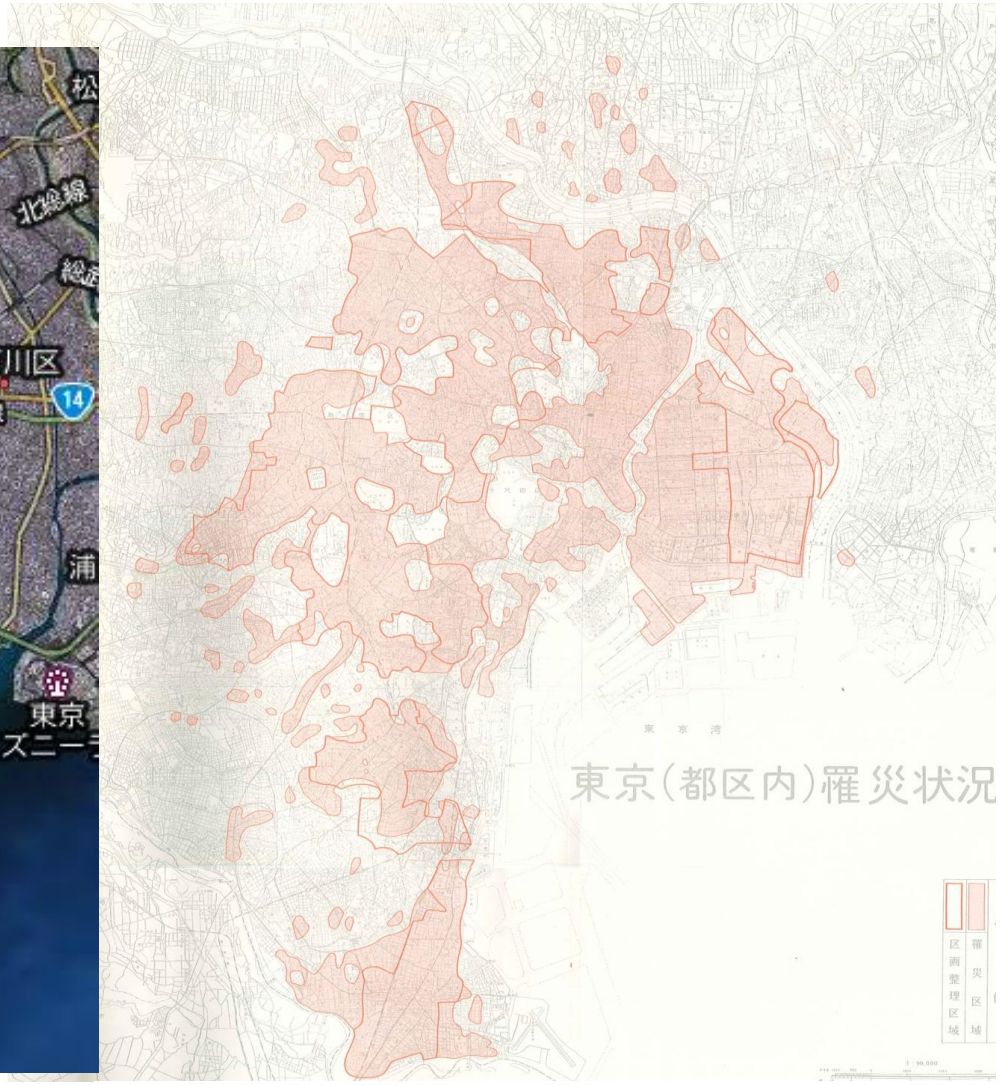
[Asakusa,Tokyo]

Source: "National Museum of Nature and Science" Home Page, http://research.kahaku.go.jp/rikou/namazu/

2. History: World War II (-1945)

An area of 41.2km^2 in Tokyo was destroyed by fire caused by bombing in 1945.

Source: Google map

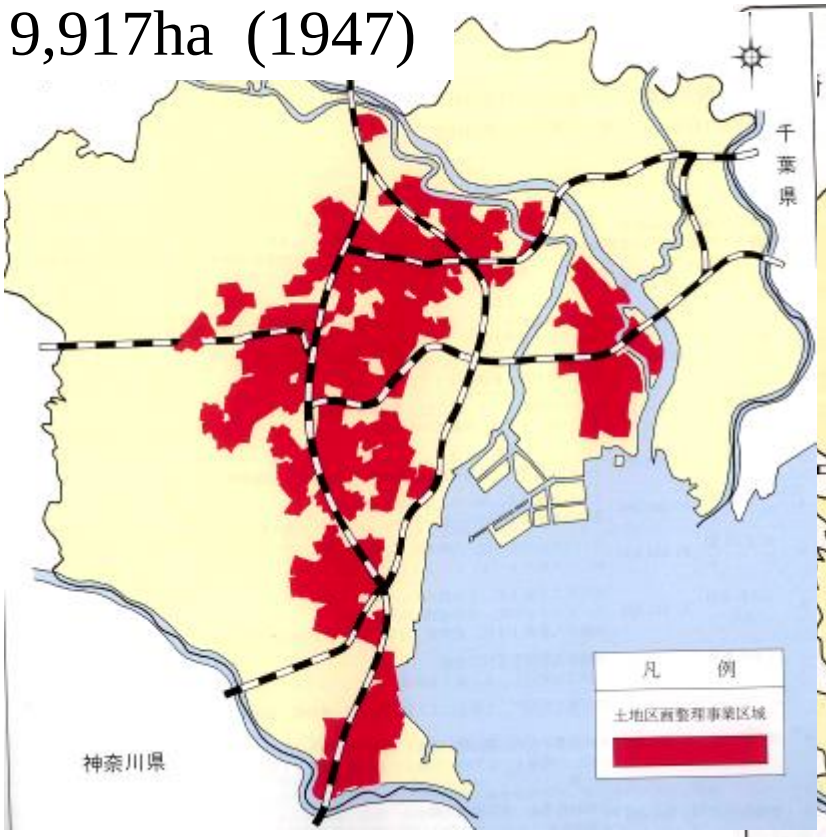


Source: 'Report on Reconstruction from War Damage', City Planning Association of Japan, 1959

2. History: Reconstruction from WWII

Tokyo was among the 102 cities implemented major LR program for reconstruction.

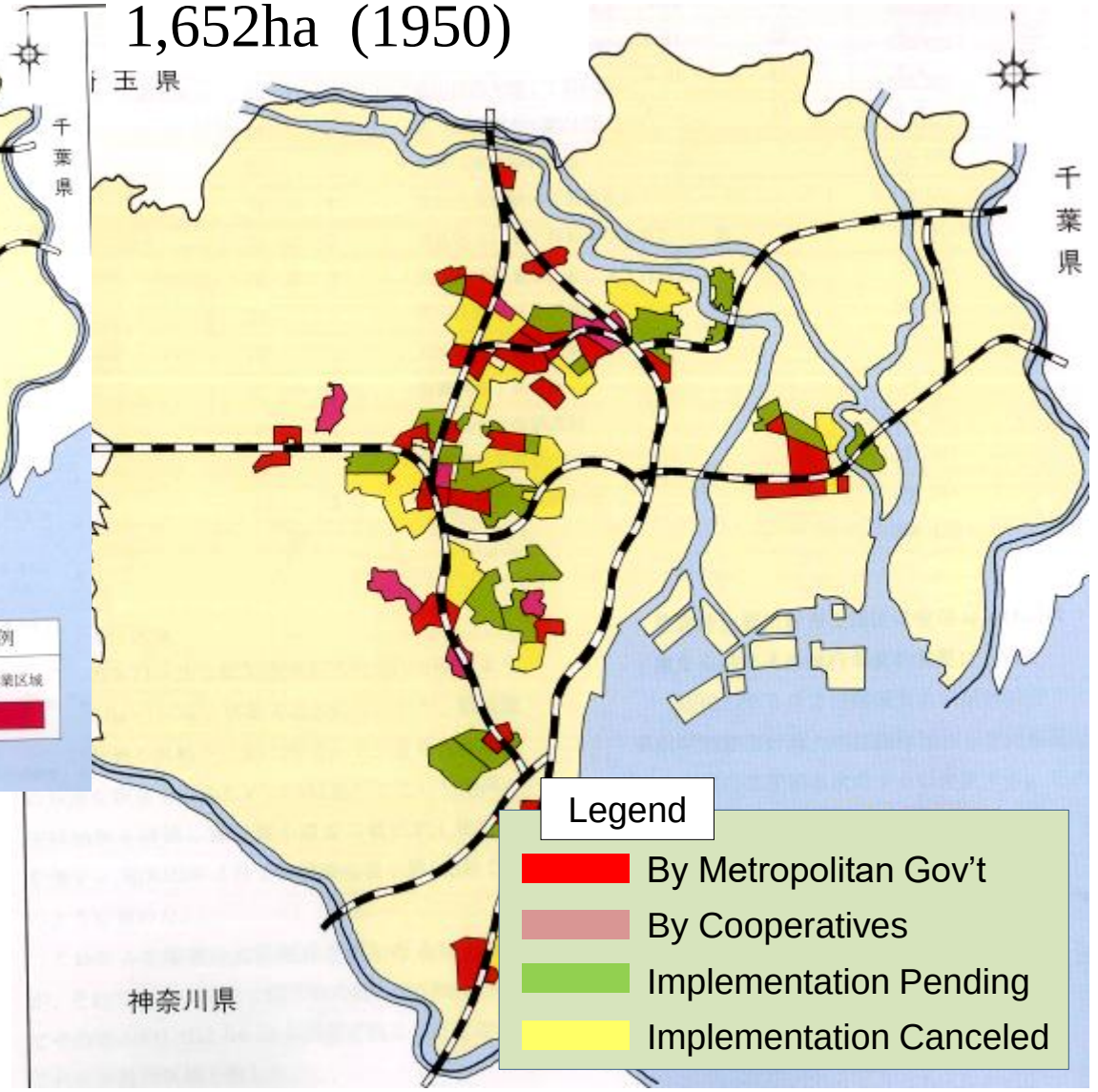
9,917ha (1947)



Legend

Areas to Implement Land Readjustment

1,652ha (1950)



2. History: Transport

Edo City was one of the largest cities in 19c with a population of 1 million. Still, the main mode of transport was walking.

- People walked. No horse carriages. You can ride a palanquin, or 'Kago', if you can afford. Therefore, roads in Edo were narrow.

A picture of Nihonbashi around 1830.

The bustling crowds on Nihonbashi Bridge in central Edo, the starting point of Edo's Five Major Roads (around 1830)

Source: THE TOKYO METROPOLITAN EXPRESSWAY（1999）
"Easy to Understand Urban Transportation--1988." Society for the Study of Urban Transportation

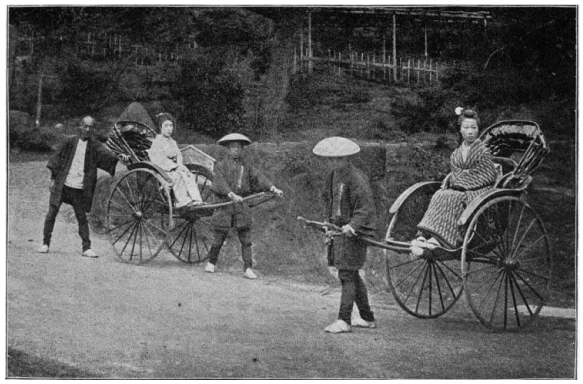
Japanese palanquin

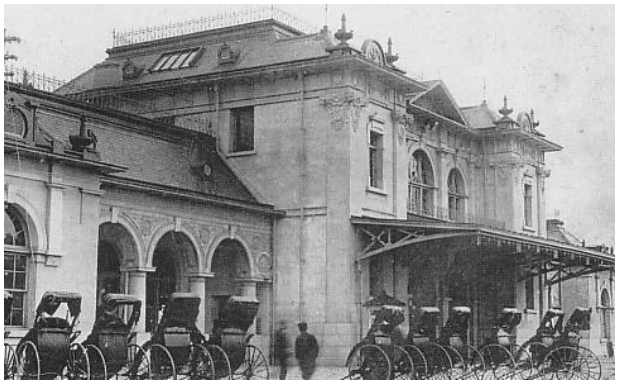
岐阻道中 熊谷宿八丁堤ノ景 渓斎英泉 江戸時代(19c)

2. History: Human and horse powered modes in late 19th century

Rickshaws took over palanquins in late 19c as horse train also started operating in Tokyo.

- As the road became better, rickshaws took over palanquins by around 1870s.





Human Powered Vehicle

人力車

Jin - Riki - Shah

rickshaw

Source: Wikipedia

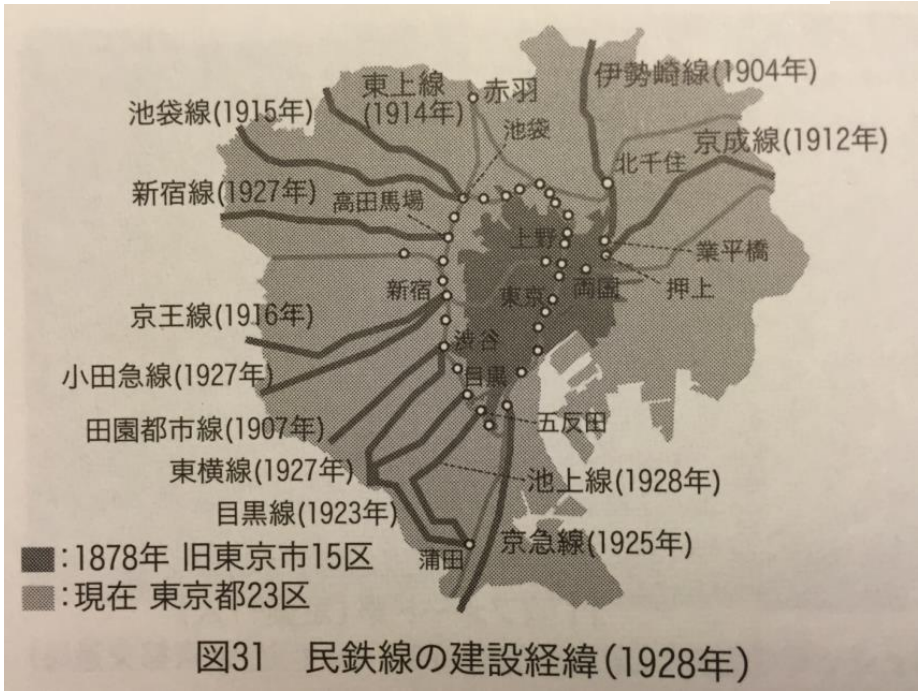
- In 1882, horse train came to Tokyo to connect Nihonbashi and Shinbashi.

https://www.library.metro.tokyo.jp/Portals/0/edo/tokyo_library/modal/detail.html?d=54

2. History: Tram network's expansion in the first half of 20c

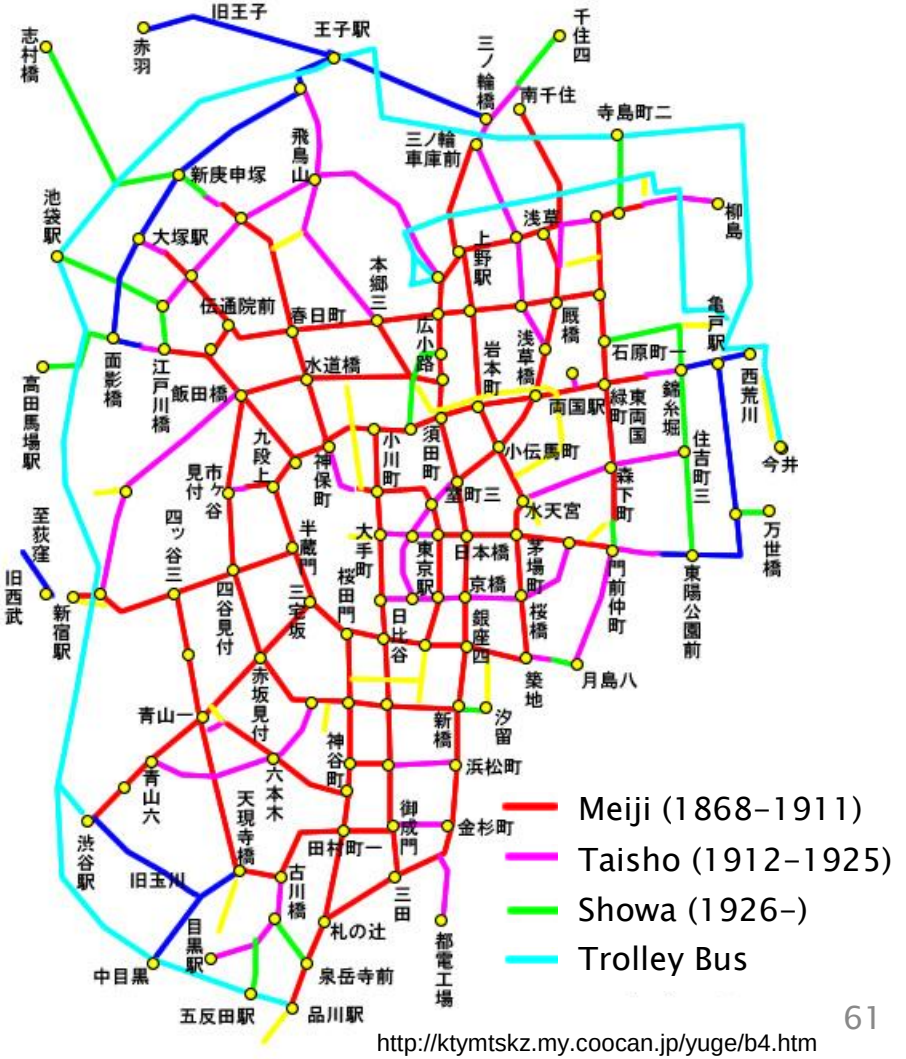
Since the first tram came in 1903, the network expanded quickly to cover inside and outside the Yanomote circular line.

Private Railways/Trams by 1928



Source: Yajima and Ieda, 2014. Global City Tokyo Developed by Railway

Tokyo's Public Tram network in 1958



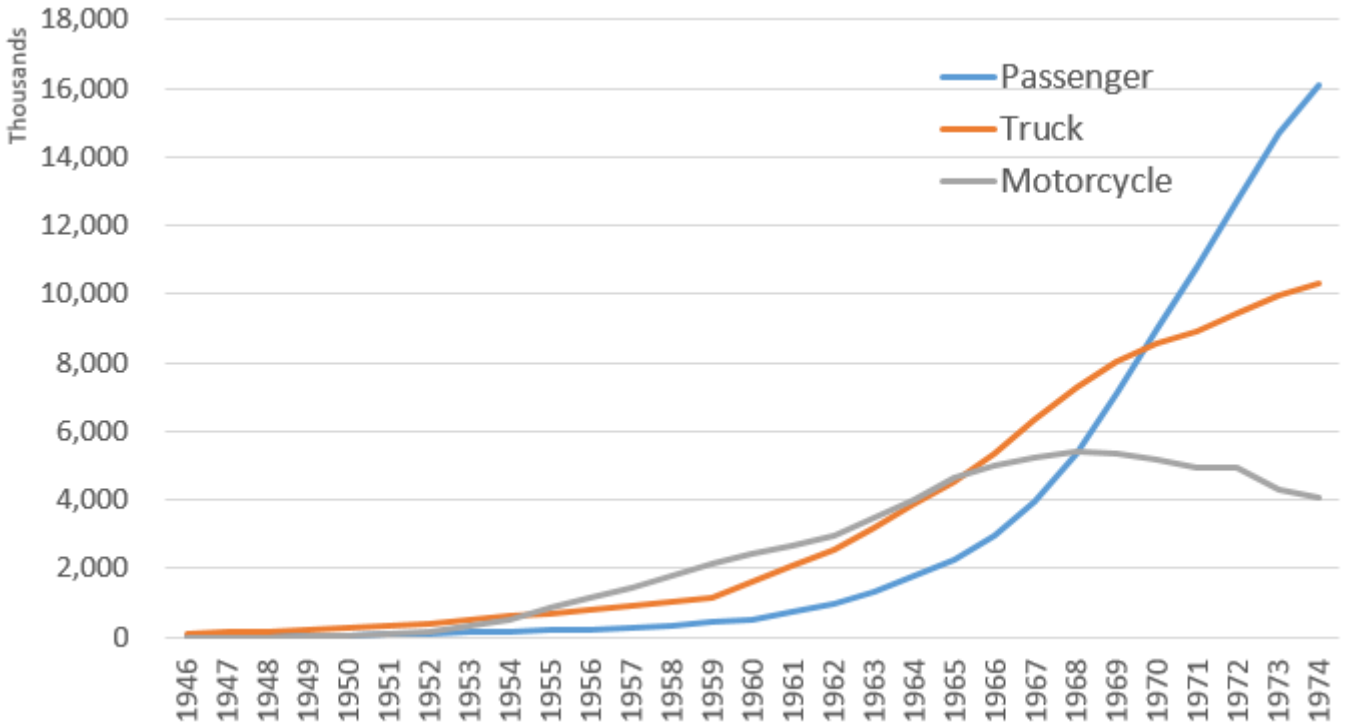
http://ktymtskz.my.coocan.jp/yuge/b4.htm

2. History: Slow onset of motorization

Rapid expansion of rail network affected slow onset of motorization, and vice versa.

- While economic development happened before WWII, motorization didn't really happen until 1960s because of relative expensiveness of cars, poor road condition, and availability of rail network.

Car Ownership in Japan (1946-1974)



https://www.npa.go.jp/hakusyo/h17/hakusho/h17/html/G1010000.html

2. History: Road congestion in mid-20c

As motorization picked up in 1960s, Tokyo's roads got congested with cars, trams, and other modes.

Source: 50 Year's History of the Metropolitan Government

2. History: Metropolitan Expressway

Following the onset of motorization, Metropolitan Expressway was constructed targeting the Olympic Games in 1964.

Metropolitan Expressway Network opened 1964-1970

1st Opening in 1962

Construction of Circular Route (1967)

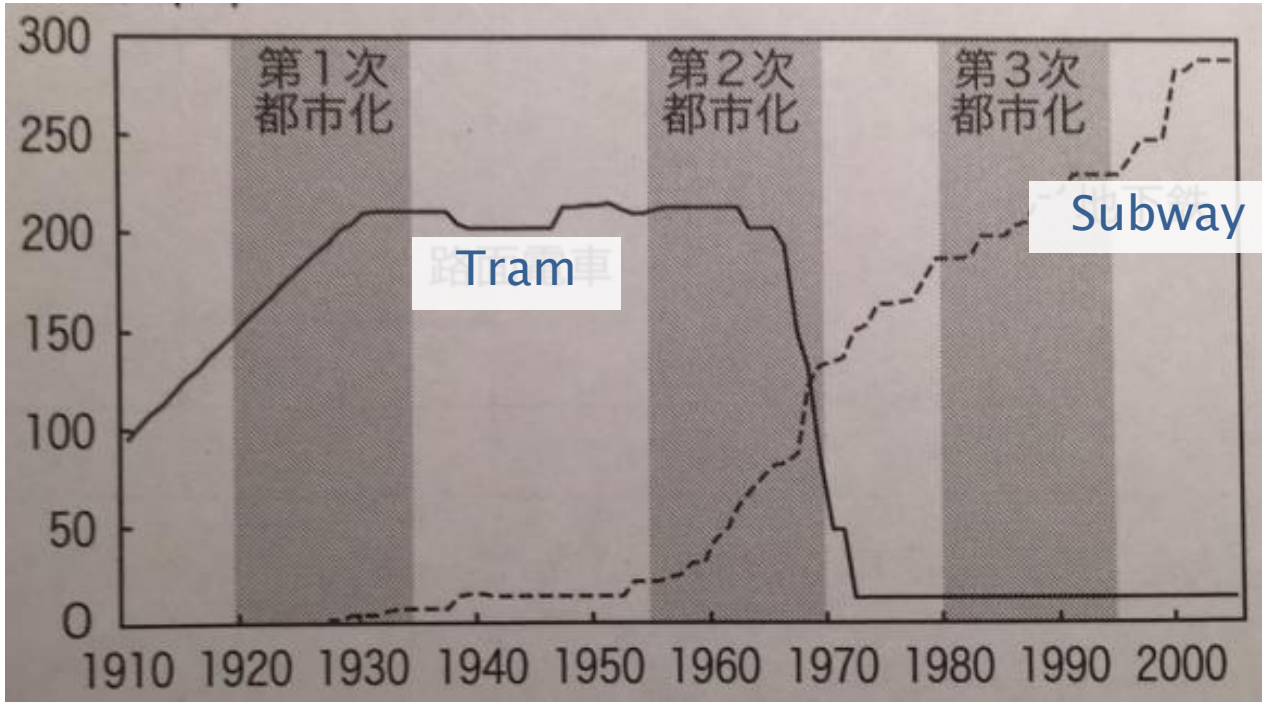
昭和 42 年 6 月　環状線建設現場

http://www.hido.or.jp/14gyousei_backnumber/2012data/1212/1212shutoko_50th.pdf

2. History: Fall of tram and rise of subway

Trams were quickly replaced by the subways in late 1960s to early 1970s.

- With congestion on roads, trams suffered from delays and increasing number of accidents that made the mode unpopular, especially in light of the expanding subway network.
- Trams had more than 200km of network at its peak, but now has only 17km in Tokyo. Existing lines run on dedicated tracks except for a few hundred meters of tracks on road.



Source: Yajima and Ieda, 2014. Global City Tokyo Developed by Railway