

# The supremacy of Japanese railway system

Japanese trains – the best in the world (?)

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# The five stages of grief journey

## 1. Access to the station

The journey begins at home – how do you get to the train station?

## 2. Ticketing

The financing of the system

## 3. On the route

Frequencies, interchanges, lines

## 4. Getting there

I am at the station I wanted to get to – what comes next?

## 5. The habits

My grandfather used the train, my father used the train and so I'm gonna use it

# Kantō Main Metropolitan Area

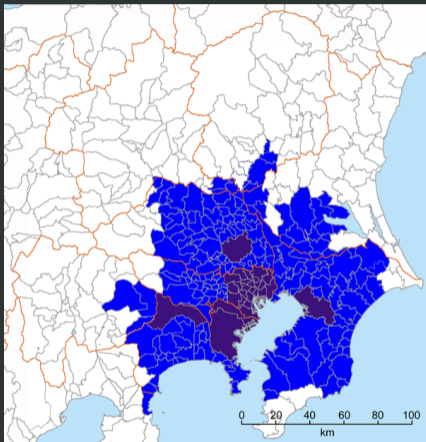


Figure: Wikicommons, user KzaraI, CC BY-SA 4.0

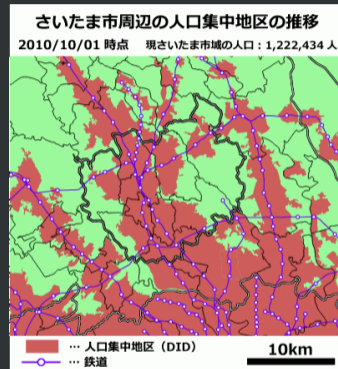


Figure: Densely populated areas in the Saitama city in the northern part of the metropolitan area. Clearly concentrated around railway lines and stations. Wikicommons, user VSA-itama-1710, CC BY-SA 3.0

One of the two definitions of the Tokyo metropolitan area used by the Statistics Bureau of Japan. Examples from this area will serve to show the issues related to the subject matter. What is relevant here:

1. the area consists of all municipalities from which min. 1.5% of the population commute to work in the 23 districts of Tokyo, or to any of the major cities Yokohama, Kawasaki, Sagami-hara, Chiba or Saitama;
2. the area's population is approximately 37 million;
3. the area does not have a joint management (Tokyo Metropolis is only the Tokyo Prefecture area);
4. the Tokyo agglomeration is a decentralised agglomeration – it does not have a single place of concentration of a large part/majority of services or service/office jobs, but several/multiple such districts/districts of concentration, with greater dispersion of services also across other municipalities/districts;
5. the concentration of focal points around railways also results in settlements, including those with high population density, being built around metro/railway stations, creating an urban environment that favours rail as the primary mode of transport.

# Access to the station



# Urban planning, transit-oriented development

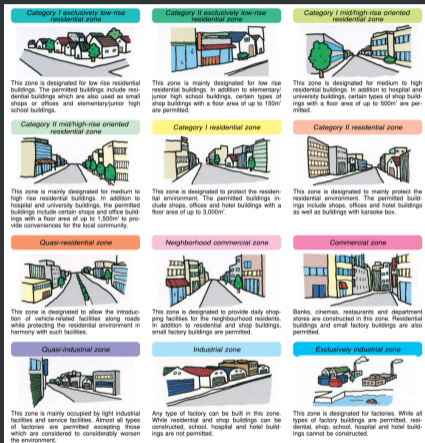


Figure: Introduction of Urban Land Use Planning System in Japan; Ministry of Land, Infrastructure and Transport



Figure: © OpenStreetMap contributors

1. The dispersal of the focal points means that passenger flows are not as one-sided as in the USA, for example - the phenomenon of 'leaving the suburbs' in the morning and 'returning to the suburbs' in the evening is much less pronounced. This has a positive effect on the distribution of the traffic flows on the network. When the distribution of passengers is at its peak, the trainsets return to the suburbs empty, and an empty train costs the same as a full train, and there must be a lot of trainsets, otherwise people do not fit into the centre. Where traffic is more bi-directional – passenger streams are more spread out, both providing greater comfort for passengers and allowing costs to be contained.
2. In addition, good zoning is important – local service centres with concentrations of shops, restaurants, services, etc. should be created around railway stations and other transportation focal points. This is fostered by appropriate zoning that allows a mix of residential and commercial development, bringing people more closely to the mode of transport, unlike in the United States, where strictly mono-functional zoning (residential, service and industrial zones) results in a dispersion of development and services.

# Ticketing





# The plurality



Figure: Wikicommons, user FML, CC BY-SA 3.0

1. two JR regional companies (JR East (JR 東日本, *JR Higashi-Nihon*), JR Central (JR 東海, *JR Tōkai*));
2. eight large private companies with a total of 55 lines;
3. four third-sector networks;
4. five small private railways;
5. six monorails;
6. three metro networks, two separate metro lines;
7. one tramway network;
8. two people-movers.

The transport network in the Tokyo metropolitan area is, of course, extremely extensive. Third sector companies are so-called public-private partnerships, i.e. a local government forms a company together with a private railway company to maintain operations on a loss-making railway line. People-mover (small automated railway) is the name for small networks of automated transport running on viaducts, tunnels or other forms of separation. Companies and lines subsisting on tickets and other forms of commercial activity, without subsidies, are standard on Japanese railways. The large proportion of privately owned railways is due to the fact that at the time of nationalisation in the early 20th century, not all railway companies were nationalised, but only those that were necessary to create a nationwide grid with a gauge of 1067 mm, which allowed state transports (such as the military) to be performed on a priority basis. After nationalisation, however, the Japanese government prohibited private companies from establishing their terminal stations inside the Yamamote regional line, allowing for the through-running.

# Payment systems, fare integration at the local level



Figure: Sujay25, Wikicommons, CC BY-SA 2.0



Figure: Lombroso, Wikicommons, public domain

The transport system in the Tokyo metropolitan area or Japan in general is quite fragmented, with minor exceptions there are no inter-company integrated tickets. In the last 16 years, however, all systems have been integrated into city card systems (IC – Integrated Circuit card), which are additionally interoperable with each other. In the Tokyo Metropolitan Area, there are mainly two in use – Suica and Pasma, which are, however, interoperable – you load money onto one and can pay for travel on all transport systems in the city, including private railways, buses and so on. A lot of shops even allow payments paid with these cards. Interestingly, mobile payments using this technology in Japan appeared as early as 2006. They use FeliCa technology (developed by Sony), instead of western NFC, so not all phones support this. Of the phones available in the west, this is basically only available on the iPhone from version 7 onwards (and of course on Android phones sold in Japan). Originally the systems were not integrated – each company used its own media (usually paper, but not exclusively, also e.g. magnetic cards) for tickets and fares. After the introduction of first the Suica card and then others, integration began. First it was the interoperability of Suica and ICOCA cards, so that they could also be used in Osaka. Then, on 18 March 2007, Suica and PASMO (carriers in the metropolitan area) were integrated.



1. On 23 March 2013, city card integration was introduced at national level. It is not a full integration with every carrier, but it is usually possible to at least use the same card for single journeys or time fares. However, local cards are usually used for season tickets. Unlike European transport systems, there is no pressure to introduce open-loop (transport payments using standard contactless payment cards), thus exploiting the advantages of a closed system, such as the possibility to use technology more suited to transport payments at ticket gates (EMV reading time of 500 ms, FeliCa 200 ms, Octopus 100 ms) or others related to another, more commercial aspect.
2. National System (IC) cards can also be used for payments. The money thus remains in the system (the card operator – the railway company – acts here as a quasibank, benefits from unused money and collects interest income on the deposited money). In addition, they allow the use of synergies: the passenger pays at the railway station shop using the card (providing both a commission for the operator and facilitating the use of the shops at the station). Payments were supported by 210,000 shops in 2013 (however, PiTaPa is post-pay and does not allow in-store payments).

# On the route



# Context that lies in technicalities

Four different rail gauges are common in Japan:

- ❑ 1067 mm, 22301 km, so-called cape gauge
- ❑ 1435 mm, 4251 km, Shinkansen and some metro networks
- ❑ 1372 mm, 96 km, Keiō-sen, trams
- ❑ 762 mm, 48 km, small regional lines



Figure: Bakkai, Wikicommons, CC BY-SA 3.0



Information about the rail gauges found on Japan's railway networks, including those in the Tokyo metropolitan area, is necessary for us to understand the technical complexities involved in the possible integration and overflight of trainsets between the networks of different carriers. As only part of the railway network was nationalised (through a partly voluntary buyout) during the period of railway nationalisation in Japan in the early 20th century, of the dozens of private suburban railways that remained, not all undertook the expensive adaptation of the infrastructure to the nationally standard cape gauge, which for obvious reasons causes difficulties in integrating services (however, I omit power supply issues from consideration here, for example, due to the fact that multi-system rolling stock is available).

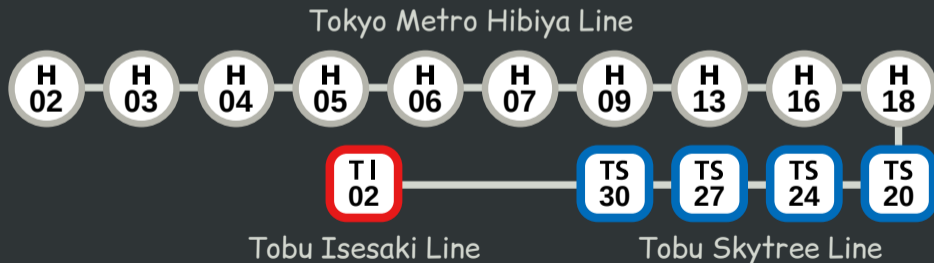
# Integration and the lack of



The reader may have noticed that in the central area of the slide is the Yamanote Line, the most important railway line of the Tokyo metropolitan area. It roughly delineates what we might call the central area of Tokyo. In the pre-war period, the Ministry of Railways did not authorise private railway companies to build inside the area, hence they built to the vicinity of the area, which today manifests itself as the terminus stations of these railway lines at the Yamanote Line stations. This, in turn, caused, and still causes today, a heavy load on the circular line. Among other things, the Tokyo underground plan (coloured lines on the slide) was developed to solve this problem; 13 lines (including the Ginza line, which was established before the war) were planned in such a way as to allow trains of private companies from adjacent lines to also operate on them. Often the adaptation was quite crucial - for example, the Shinjuku line of the Toei Subway has an unusual gauge of 1372 mm to preserve the possibility of operating trains from the Keiō railway company's lines, which use this gauge. Another example is Tokyo Metro's Hanzōmon line, which, although very short (14 stations, 16.8 km long), allows very long through trains to run on the private railway networks of Tobu and Tōkyū. The longest through line is almost 100 km long and runs between Minami-Kurihashi on the Tobu Nikko line and Chūō-Rinkan on the Tōkyū Den-en-toshi line.

# TH Liner

Operator: Tobu Railway Co., Ltd.



Through traffic can operate both for services operating on lines that stop at all stations and for different types of fast lines. Such an example is, for example, the TH liner operated by Tobu Railway, a home liner service (a light rail train that bypasses some stops and sometimes requires a surcharge, with guaranteed seating) established in June 2020. As we can see, it starts its route on the Tobu Iseaki line and then enters the metro via the Tobu Skytree line, where between Ueno and Kasimugaseki stations it does not stop at most stations, while between Kasimugaseki and Ebisu it stops at all stations, functioning as a metro reinforcement for this section (no additional tickets are needed for this section either).

# Integration and the lack of

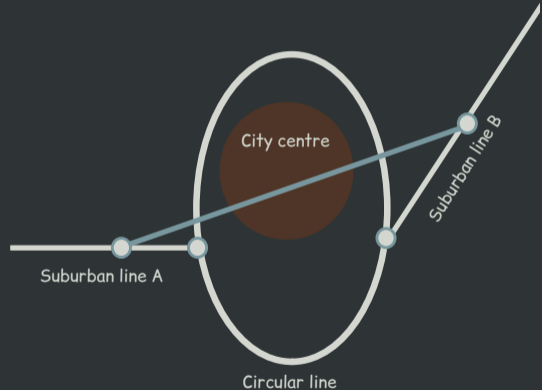
<b>Station</b>	Keisei-Takasago	Komuro	Inba-Nihon-Idai	(Tsuchiya)	Narita Ter. 2·3	Narita Ter. 1
<b>Carrier</b>	Keisei Electric Railway					
<b>Owner</b>	Hokusō Railway	Hokusō Railway	Chiba New Town Railway	Narita Rapid Rail Access	JR East Narita Airport Rapid Railway	
<b>Route</b>	<i>Existing</i>			<i>Newly constructed</i>		<i>Existing</i>

**Table:** Keisei Narita Airport Line, the owner: Keisei Electric Railway

Another interesting example is the Narita Sky Access. This line allows a number of through trains to enter (Keisei Main and Keisei Oshiage trains enter via the Keisei line, from the Toei Asakusa line, as well as Keikyū trains from the Keikyū Main line, Keikyū Kurihama and Keikyū Airport - from Haneda Airport). However, the infrastructure on this line is not solely owned by Keisei – it operates on the infrastructure of four different companies, of which it was only necessary to build the section between Inba-Nihon-Idai and Narita Airport Terminal 2-3 stations to achieve this effect, the rest was achieved using available capacity on existing lines. This has resulted in such a line, which is very practical and used, being built at a relatively low cost, making maximum use of existing capacity, which results in cost cutting and thus – greater economic efficiency. In this way, the benefits of using extensive interconnection integration crystallise. It is worth noting that this integration requires the cooperation of a large number of actors, yet it is possible, ensuring efficient use of infrastructure and reducing costs when creating new connections and extending existing ones.

# Integration and the lack of

- ❑ Reducing the passenger load on the line **and the stations**
- ❑ Reduced travel time, reduced number of transfers
- ❑ Increasing the number of transfer stations
- ❑ Increasing the decentralization of the city itself
- ❑ Reducing costs and risks for operators, including infrastructure maintenance and running (while increasing the revenue)





However, through-running also has other advantages, like capacity management. In principle, the interchange in urban rail transport is not something to be feared. They are an integral part of well-functioning systems, and to build such a system one usually opts for a system of a limited number of lines in which transfers are needed to make most connections, which, with high frequency, is not a problem, and which provides much greater resistance to impediments and transparency compared with a system in which lines overlap, giving higher section frequency but providing low-frequency direct connections to various points. However, at some point such solutions may not be sufficient. The problem may be the load not even on the lines but on the stations (this is, for example, one of the reasons why the Northern Line in London has not been split in two, but remains a kind of double line – Camden Town interchange station is too crowded and the division would add new changes), which can be offset by creating direct through connections, allowing more interchange points and eliminating the need to transfer on the busiest relationship.

# Classification and numbering

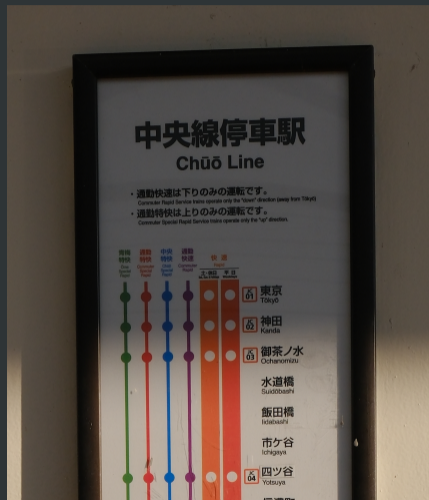


Figure: taro96b, Flickr, Wikimedia Commons, CC BY 2.0



Lines as such are not usually numbered but have names, e.g. the Yamamoto line. There is numbering, but it is used for technical purposes; it is not used by passengers. In addition, however, there is some language neutral signage as well – station numbering. Station numbers, however, are not just numbers – the numerical markings also include line symbolism (shape, colour, abbreviation of the name) allowing identification of the line without knowing the language or knowing how to pronounce the station name. The classification of trains varies from company to company, but the most popular categories can be specified:

1. Local (普通), stops at every station;
2. Semi-Express (準急), stops at almost every station;
3. Express/Rapid (急行/快速), stops at some stations, this category has undergone the biggest changes over the last few decades – from standard (Express) corresponding to e.g. InterRegio trains, and now constituting faster regional and suburban trains (Rapid);
4. Limited Express (特急), it stops at the largest stations and operates as a long-distance category, but also as a fast regional one (it's similar to Intercity in Germany or France));
5. Shinkansen (新幹線), separate tracks, platforms, sometimes even stations.

# Getting there



# Transit-oriented development



Figure: bethom33, Flickr, Wikimedia Commons, CC BY-SA 2.0

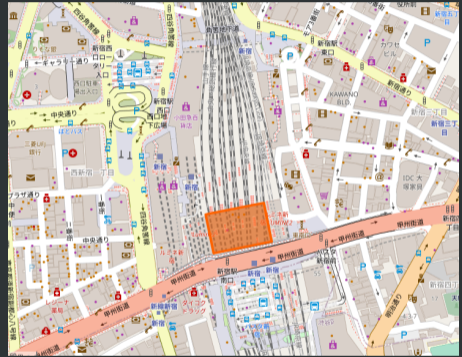


Figure: © OpenStreetMap contributors

The synergies mentioned earlier become even more important when reaching a destination. Where there is a greater concentration of services, if the location is close to a railway line, the railway company itself, or with a suitable partner, can invest in the development of commercial or office space. This has both an impact on the attractiveness of public transport among passengers and provides an additional, often very decent, income for the operator, allowing it to cover its costs (without the need for tax subsidies) or to generate a profit based on more than just tickets or advertising. Hong Kong's MTR generates revenue almost twice as much as its costs, while providing very low and attractive ticket prices, taking advantage of the fact that it owns a lot of retail, office or even residential property next to the stations. A similar strategy is used by many Asian railway companies, including many Japanese ones. This approach is also one of the practical implementations of what is known as TDD, *transit-oriented development*, or land-use planning and development of real estate centred around public transport.

# The habits



# My grandfather used the train, my father used the train and so do I


Classification		Profitable	Unprofitable
<i>JR (on Honshu: JR East, JR Central, JR West)</i>		3	0
<i>JR (JR Hokkaido, JR Shikoku, JR Kyushu)</i>		0	3
<i>Private railways (Urban)</i>	<i>Major private</i>	16	0
	<i>Quasi-major private</i>	4+7	0
	<i>Public operated</i>	8	1
	<i>Smaller private</i>	7+11	3
	<i>Monorail etc.</i>	11	10
<i>Private railways (Local)</i>	<i>Smaller private</i>	20	35+1
	<i>Transferred (new regional lines)</i>	3	30
	<i>Conventional parallel to Shinkansen</i>	1	3+1
	<i>Public operated (trams/regional cities)</i>	1	2
<b>Total</b>		<b>74+12</b>	<b>87+2</b>

**Table:** Profitability of Passenger Railway Operators (Fiscal 2010), Overcoming Difficulties Faced by Local Railway Transport and Role of Basic Act on Transport Policy, Takahiko Saito, Japan Railway & Transport Review No. 65, March 2015



The title of this talk is quite click-baity. To decide which railway system is the best would probably be quite controversial in the railway enthusiast community. Fortunately, we can ignore that. But it is nevertheless possible to identify some aspects where there is room for change/improvement, e.g. in terms of fare integration (not ticketing, that one works, but fares), it is also controversial, e.g. the way former mainline railways, after the construction of the new Shinkansen, are often extinguished or handed over to third-sector/prefectural companies. However, it is also worth noting that not every solution has to be a one-size-fits-all solution – as we can see, a lack of fare integration does not prevent the formation of appropriate travel habits, while at the same time, too deep a fare integration can result in hitherto profitable or at least self-sustaining rail connections starting to demand a tax-based subsidy. Nevertheless, any transport system is a search, because customer needs and habits change, and it is foolish to lose a customer, especially in a culture where the use of rail transport is a no-brainer.

Thank You that you stayed!

 田端駅 (一)   
 JR東日本 Tabata Station



Thank You that you stayed!



Transit policy and urban planning



Transit policy and urban planning,  
Japan

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