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ALTERNATIVE INVESTMENTS Initiative

Asian Development Bank Institute

High-Speed Rail (HSR) as a new mode of intercity passenger transportation

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Private Equity Infrastructure Investment Research Associate

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Outline

Introduction of the WAII and the Team

No.	Theme	Article focus	Presentation focus
1.	Overview of the U.S. High-Speed Rail	☑	☑
2.	Performance Comparison between conventional rail, HSR, and air transport	☑	☑
3.	Operational Dissection and Performance Measure of HSR	☑	☑
4.	A case study: New York Penn Station*	☑	☑
5.	Russia HSR Case Studies and Future Networks		★
6.	Conclusion	☑	☑

*The Northeast Corridor Gateway Tunnel Project – Penn Station existing challenges and corresponding engineering measures

Latest Activities

The Alternative Investments Initiative focuses on private equity, hedge funds, venture capital, and asset allocation. The Initiative is a global hub for the development of leading-edge research in alternative investments, which is integrated into the Wharton School's curriculum, and presented in public forums. It is a center that furthers the exploration of the theory and practice of investing in this asset class bringing together practitioners, alumni, students, and academics.

- **Infrastructure Investments (FNCE 311/811)**
- The Finance of Buyouts and Acquisitions (FNCE 251/751)
- Advanced Topics in Private Equity (FNCE884)
- Advanced Private Equity Seminar (FNCE 395/895)
- Corporate Restructuring (FNCE 391/891)
- FinTech (FNCE885)
- Hedge Funds (FNCE 386/886)
- Energy Finance (FNCE756)
- Business Strategy, Private Equity and Corporate Law (Penn Law 854)
- Shareholder Activism and Corporate Governance (FNCE 387/887 in Spring 2017)

WHARTON EXECUTIVE EDUCATION PROGRAMS IN PRIVATE EQUITY AND VENTURE CAPITAL

The Wharton School offers an Executive Education weeklong program called **Private Equity: Investing and Creating Value.** This 5-day program is designed for institutional investors as well as investment professionals aspiring to be better private equity investors. Contact: Alan Chen, Regional Director, Asia (alanchen@wharton.upenn.edu)

The Team

Macquarie - The Story of the Millionaire's Factory[1]

- King of Capital in infrastructure investment and the remarkable rise, fall, and rise again story of Macquarie

Since its beginning nearly 50 years ago, the rise of Macquarie Group and the coincident rapid creation of a large number of millionaires within the bank has garnered considerable public attention and given rise to the nickname: "the Millionaire's Factory." Much of that success has been built on Macquarie's early embrace and mastery of a new form of investing – private investment in public infrastructure projects. As a combination merchant bank and private equity fund manager, along with being an asset operator and manager, the firm grew from its origins in its home territory of Australia and is now the global leader in transport and infrastructure privatizations across the world.[2] With its success came imitators, but Macquarie remains the largest investor/manager of infrastructure investments in the world, with nearly USD 90B in assets under management (AUM) devoted to infrastructure as of 2018.

In spite of, or perhaps as a result of, its success, Macquarie Group has also attracted its share of detractors, who cynically label it the 'silver donut,' and the 'vampire kangaroo[3],' among other monikers meant to indicate that the investment bankers and fund managers have extracted, rather than created, the wealth they enjoy.

After listing on the Australia Stock Exchange (ASX) in 1996 at an initial offering price of $6, the shares of Macquarie Group (MQG) rocketed to nearly $100 by 2007. But the bank was hit hard by the Global Finance Crisis (GFC) and saw its share price sink as low as $17 by February 2009.[4] After successfully navigating the difficulties of the early months of the GFC, Macquarie has since recovered to trade above $100 through 2018 (as of October 13, 2018, **Exhibit 1**). Macquarie set a new precedent when it became the first large Australian financial institution to name an Asian woman, Shemara Wikramanayake, as its next CEO.[5] What are the lessons for investors and fund managers seeking to learn from Macquarie's success in infrastructure investing and establish a value creating position in this booming alternative asset class?

The Early Days

Macquarie opened for business in 1969 in in Sydney as Hill Samuel Australia (HSA), an outstation of the UK merchant bank Hill Samuel. The company originated from a business founded

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[1] This case was prepared by Eugene Chao (RA, Wharton) and Kevin Kaiser (Adjunct Professor of Finance, Wharton) for class discussion only. The current version is a draft – please do not distribute without permission.

[2] Cameron Gordon, Senior Lecturer in Banking and Finance University of Canberra "Competing in Global Niche Markets: The Case of Macquarie Bank", International Journal of Bank Marketing, August 2008, p.7

[3] Financial Review: Why the British are calling Macquarie 'The Vampire Kangaroo' https://www.afr.com/street-talk/why-the-british-are-calling-macquarie-the-vampire-kangaroo-20160913-grfobp

[4] James Dunn, "Macquarie – how the mighty have changed", Switzer Daily, July 17, 2013, http://www.switzer.com.au/your-money/investment-advice/share-trading/feature/macquarie-how-the-mighty-have-changed/, accessed August 2018.

[5] Emily Cadman, "Macquarie Group Appoints First Female CEO," Bloomberg, July 25, 2018, https://www.bloomberg.com/news/articles/2018-07-25/macquarie-appoints-wikramanayake-as-new-ceo-as-moore-retires, accessed August 2018.

The Team

Emer. Professor Vukan R. Vuchic
University of Pennsylvania
U.S. HSR Board
APTA Lifetime Award

Jim Venturi
Founder & CEO
Rethink Studio

Aleksandr Vashchukov
Head of Investment Division,
Moscow Metro and Ground Transport

The New York Times

Thinking Big and Bigger About New York

ReThink Studio

THE ARCHITECTS NEWSPAPER

☰ MENU TOPICS EVENTS COMPETITIONS PRODUCTS JOBS Conf

OFF THE RAILS

Jim Venturi and ReThinkNYC want to revolutionize how NYC handles train infrastructure

THE WALL STREET JOURNAL.

Europe Edition | September 8, 2018 | Today's Paper | Video

La Guardia's Runways Come Up Short

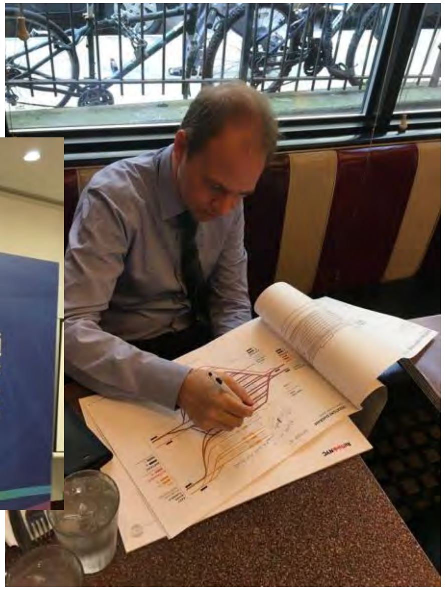
Debate reignited about whether the airport's famously short runways are safe enc

By *Mike Vilensky*

Updated Nov. 13, 2016 6:13 p.m. ET

When a jet carrying then-Repub
Pence skidded on landing Oct. 27
reignited about whether the airp
enough.

Nobody was injured after Mr. Pe



World Transport Convention, Beijing (June 2018)

Literature Review

Source: https://www.scribd.com/lists/21907475/2018-Research-and-Capacity-Development-for-Planning-Implementing-and-Operating-High-Speed-Rail-HSR-in-Asia

Literature Review (Con't)

Our Article

ADB

Conference theme:

Spillover Effects of High-Speed Rail and Quality of Life – ADB

Session theme:

HSR Case Studies and Experience from HSR operating countries

Title:

High-Speed Rail (HSR) as a new mode of intercity passenger transportation

Authors:

Eugene Chao, Research Associate, The Wharton Business School Finance Department

Vukan R. Vuchic, Emeritus Professor, University of Pennsylvania Systems Engineering Department

Aleksandr Vashchukov, Head of Investment Division, Moscow Metro and Ground Transport

Abstract:

High-Speed Rail is a new mode of intercity passenger transportation. The article reviews the history of the U.S. HSR development and makes a comparison of peer countries' HSR development. With the rapid progress of HSR and the successful competition with cars and air travel between medium to long distances (150 and 1,200 km), HSR has an increasing role in the intercity travel worldwide. The decision-makers, transportation planners, system designers and operators, as well as political leaders need to understand the HSR operational boundary as it to intercity travel in which HSR would outperform one and another under which condition. The analysis uses a simple time-distance factor to clarify the dominance. To validate the validity of HSR in the intercity passenger rail services, a comparison to the external competition of car and air travel is necessary. Meanwhile, an internal examination of operational performance under the overlay of sophisticate variables is an imperative step. The dissection, based on numerous HSR projects, selects four interrelated trade-off elements: passenger access time and travel time associated with the total on-line travel time, area coverage associated with station density, station density associated with speed, and transit unit (TU) size, frequency, and loading factor associated with an independent line capacity. After examining the interrelations and trade-offs, a practical case study represents one of the major U.S. economic corridors – the Northeast corridor. The case study explores the geospatial metadata and concludes three major system efficiency challenges; therefore, provides corresponding engineering measures to convert an independent dead-end terminal to an integrated through-running station, which are the priority of converting the Amtrak, the U.S. national rail, to an accelerated HSR service. It is time to renew the government's interest in paying a systematic attention to the comprehensive effect of the HSR.

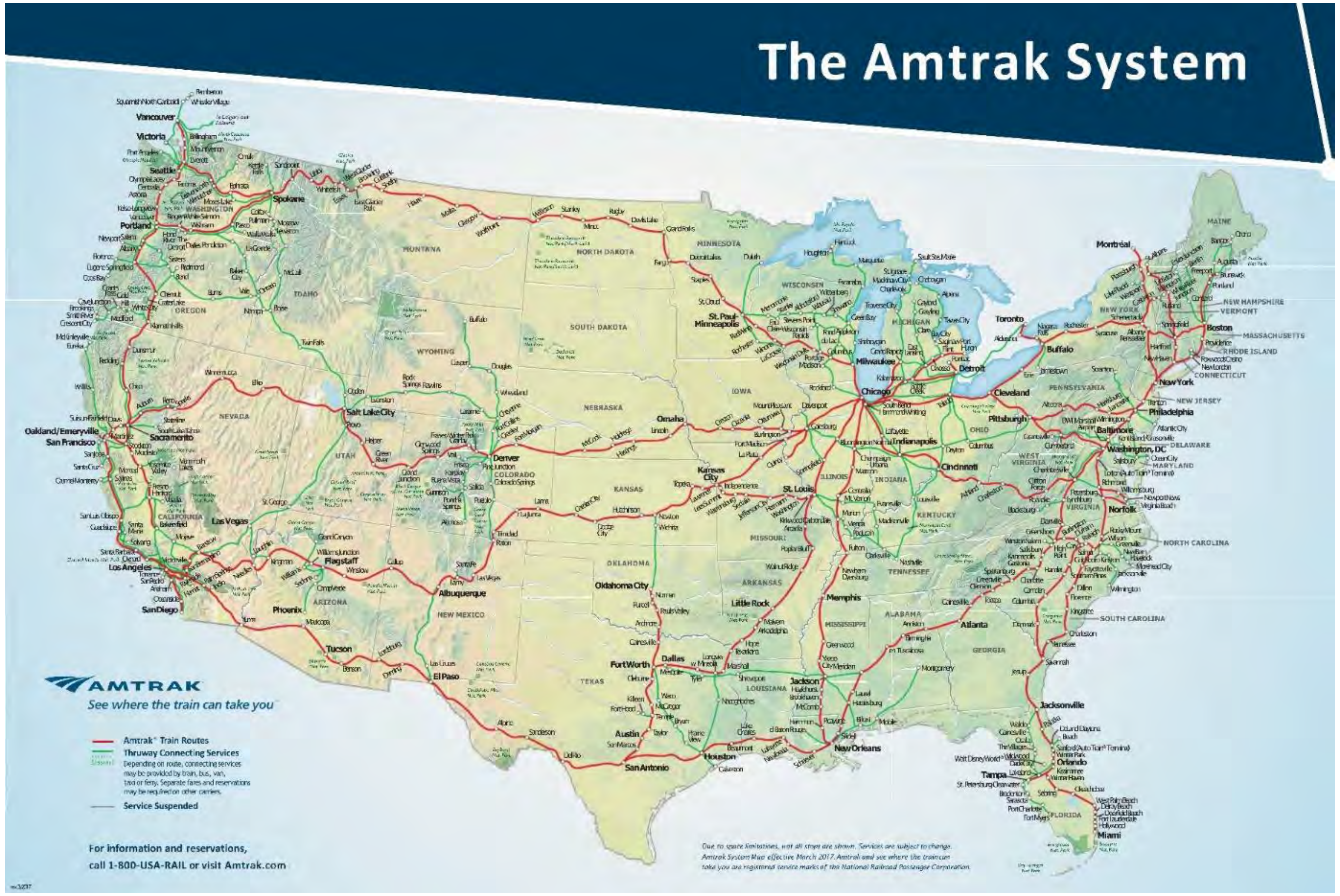
Keywords: High-speed Rail, Regional Connectivity, Comprehensive Effect, System Performance, Operational Measure

Abstract

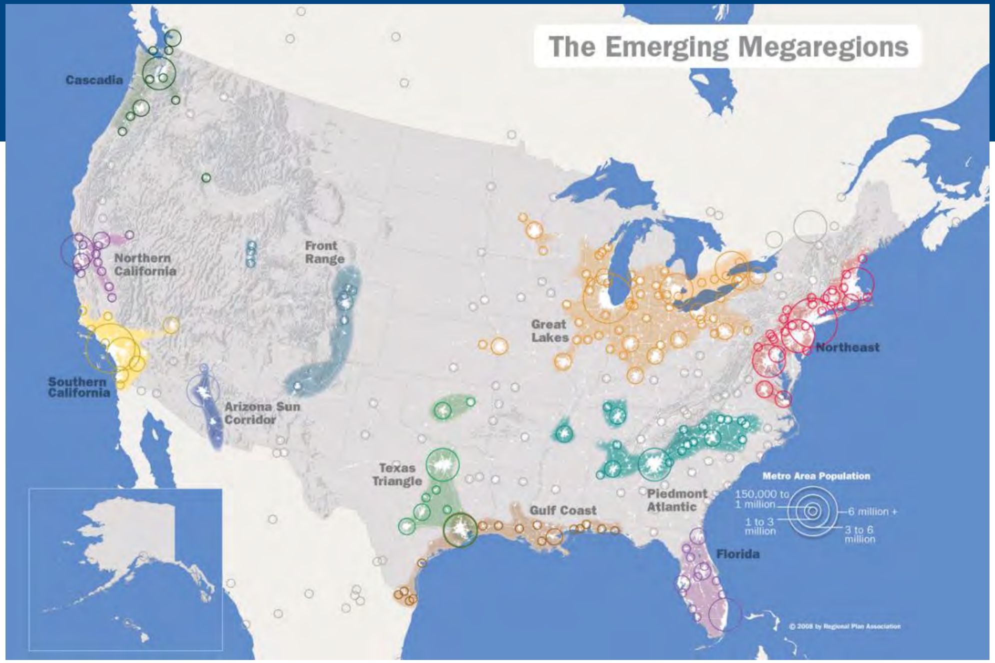
High-Speed Rail is a new mode of intercity passenger transportation. The article reviews the history of the U.S. HSR development and makes a comparison of peer countries' HSR development. With the rapid progress of HSR and the successful competition with cars and air travel between medium to long distances (150 and 1,200 km), HSR has an increasing role in the intercity travel worldwide. The decision-makers, transportation planners, system designers and operators, as well as political leaders need to understand the HSR operational boundary as it to intercity travel in which HSR would outperform one and another under which condition. The analysis uses a simple time-distance factor to clarify the dominance. To validate the validity of HSR in the intercity passenger rail services, a comparison to the external competition of car and air travel is necessary. Meanwhile, an internal examination of operational performance under the overlay of sophisticate variables is an imperative step. The dissection, based on numerous HSR projects, selects four interrelated trade-off elements: passenger access time and travel time associated with the total on-line travel time, area coverage associated with station density, station density associated with speed, and transit unit (TU) size, frequency, and loading factor associated with an independent line capacity. After examining the interrelations and trade-offs, a practical case study represents one of the major U.S. economic corridors – the Northeast corridor. The case study explores the geospatial metadata and concludes three major system efficiency challenges; therefore, provides corresponding engineering measures to convert an independent dead-end terminal to an integrated through-running station, which are the priority of converting the Amtrak, the U.S. national rail, to an accelerated HSR service. It is time to renew the government's interest in paying a systematic attention to the comprehensive effect of the HSR.

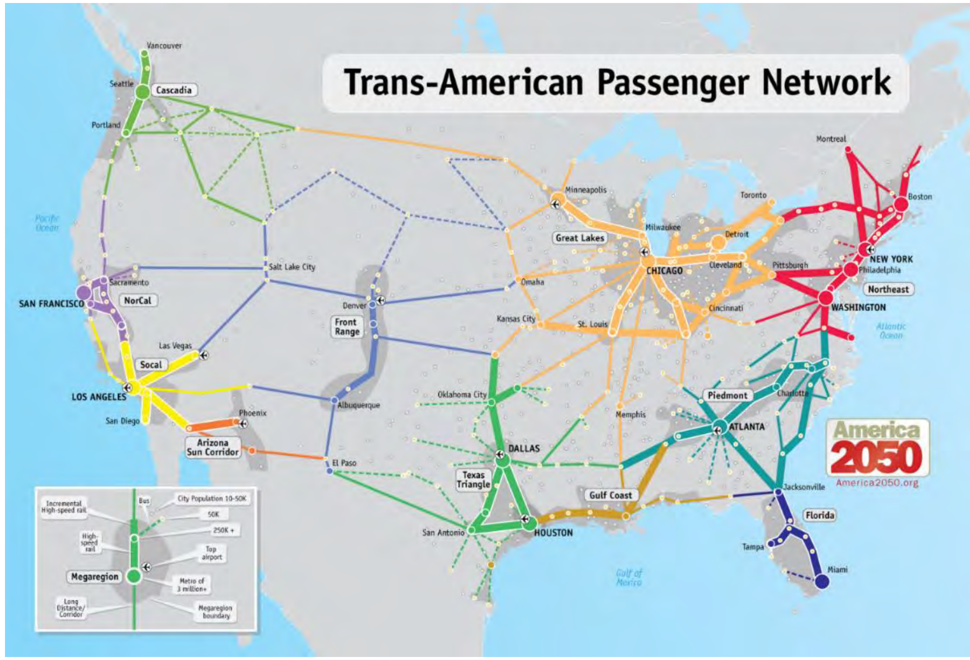
1. Overview of the U.S. HSR

Amtrak - U.S. National Intercity Passenger Rail System was founded in 1971 to serve to megaregion



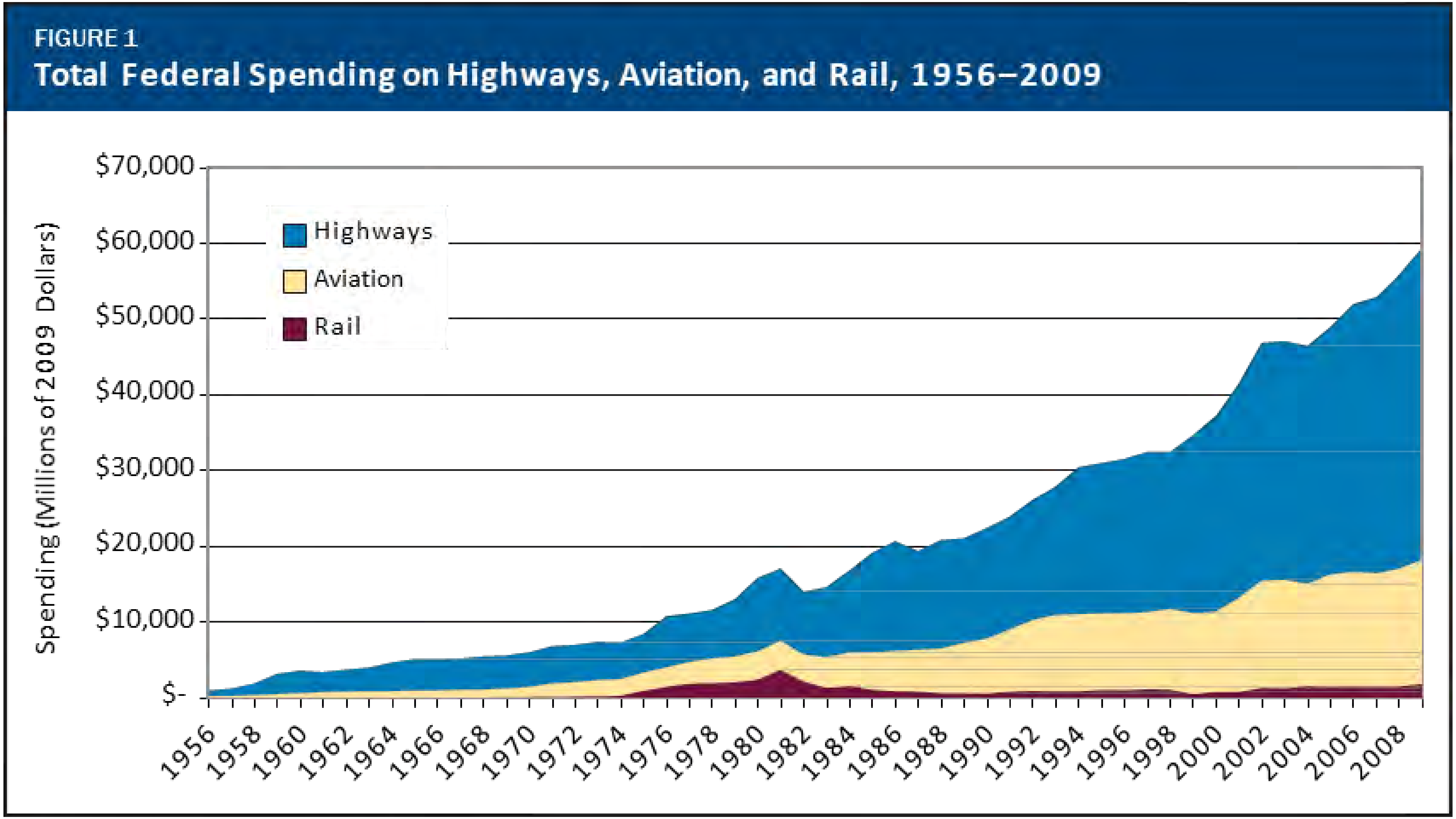
https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/Maps/Natl-System-Timetable-0317.pdf





Source: High-Speed Rail in America, Regional Planning Association, 2011
http://www.america2050.org/2011/01/high-speed-rail-in-america.html

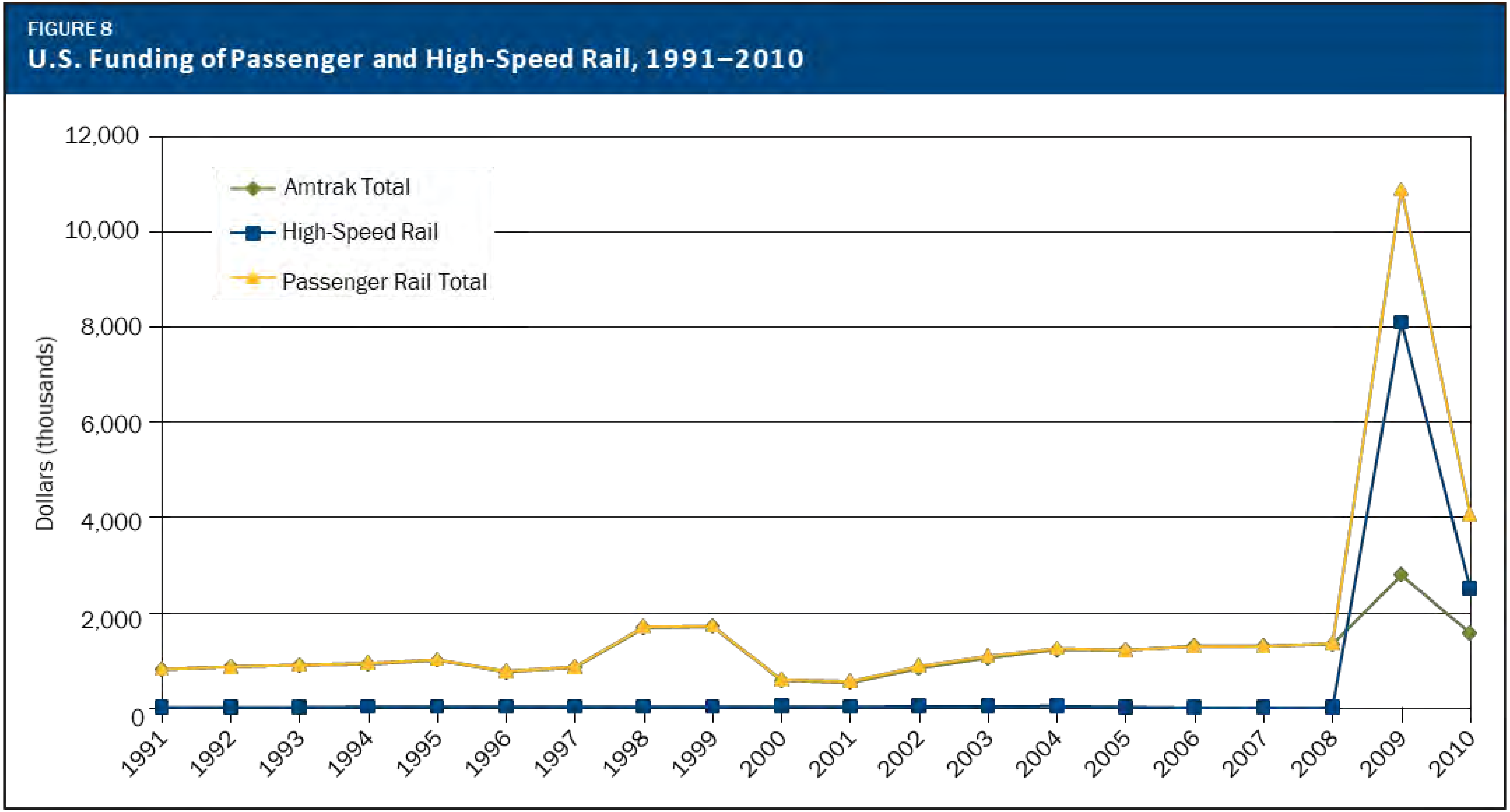
Historical U.S. fund distribution across common intercity modes



Data Source: Congressional Budget Office (2010).

Source: High-Speed Rail International Lessons for U.S. Policy Makers, Lincoln Institute of Land Policy, 2018
https://www.lincolninst.edu/sites/default/files/pubfiles/high-speed-rail-full_0.pdf

Historical U.S. rail fund distribution



Note: Dollars not adjusted for inflation.

Source: National Association of Railroad Passengers (2008).

Source: High-Speed Rail International Lessons for U.S. Policy Makers, Lincoln Institute of Land Policy, 2018
https://www.lincolninst.edu/sites/default/files/pubfiles/high-speed-rail-full_0.pdf

The Vicious Circle of the underfunded U.S. HSR and negative effects

Lack of legislative support

Competing interest among states and political parties

Lack of coordination at administrative levels

Special interest groups and lobbyists

→ Self-liquidate & Underfunded situation

→ Maximize revenue

Insolvency

Accumulated pension liability

Reduce performance and low/ aging asset utilization

→ Astronomical fare

Reduce O& M, training, services

Cut services / No expansion

Less operating ability to generate revenue

↓

Negative external effects

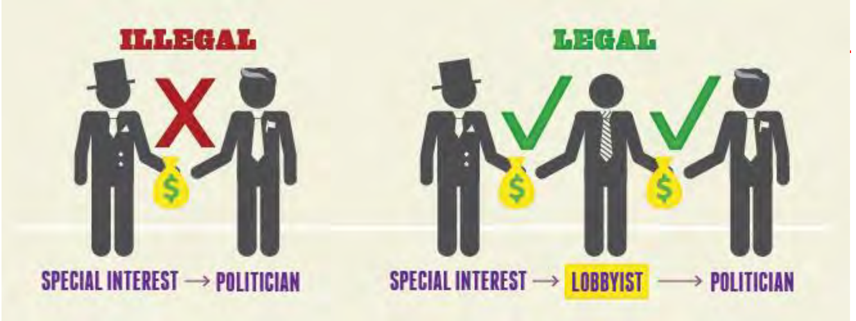
Elastic demand to low-cost operator (i.e. bus)

← Congestion on intercity highway and regional corridor

Low-cost airline demand increase with low quality services

← More funding supports to highway and airport expansion

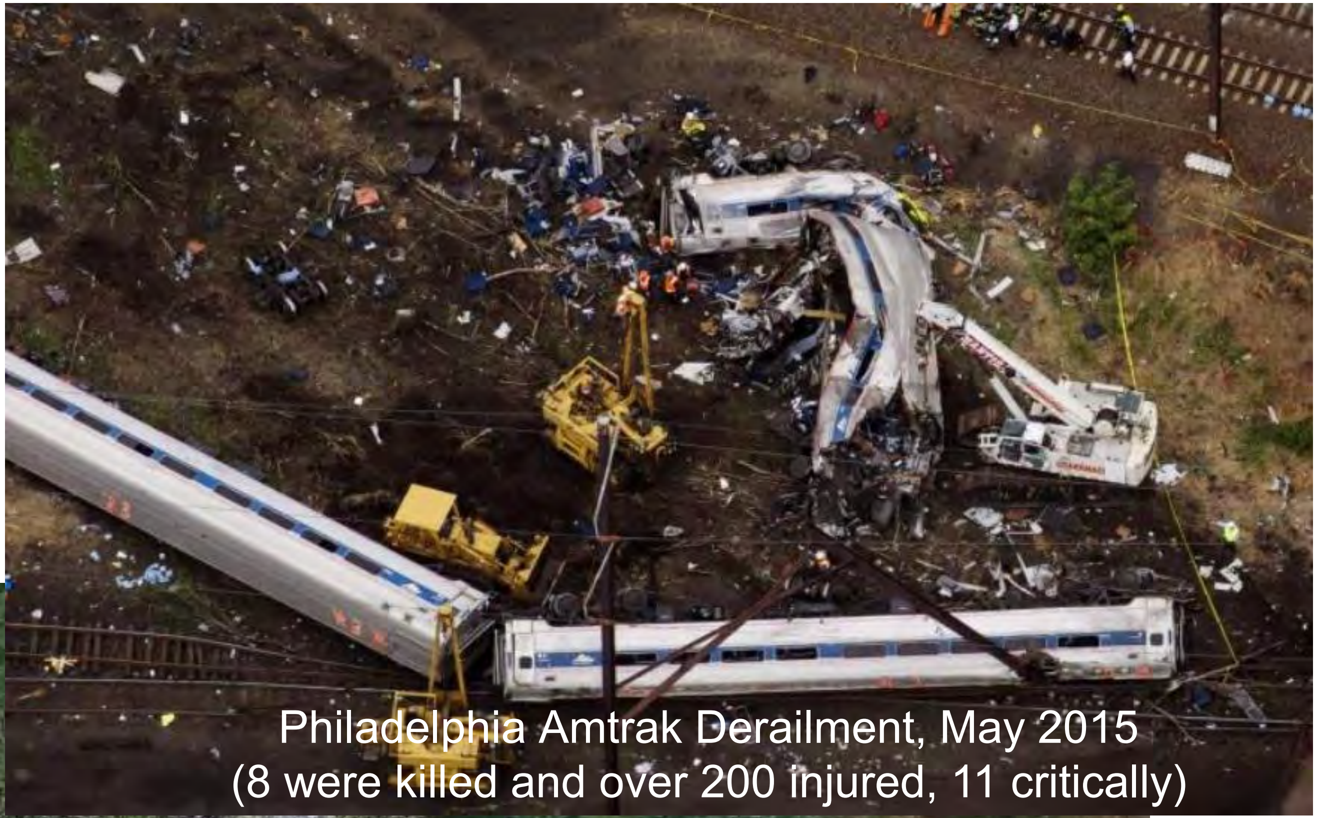
Lobbyists ↑



Source: GAO analysis of the Lobbying Disclosure Act of 1995, as amended. | GAO-18-388

*Narrative, but not mutually exclusive

Reduce O& M, training, services due to under-funded led to massive catastrophe

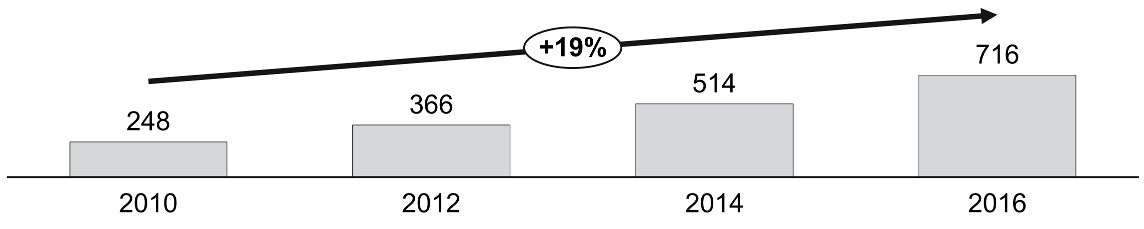


2. Performance Comparison between conventional rail, HSR, and air transport

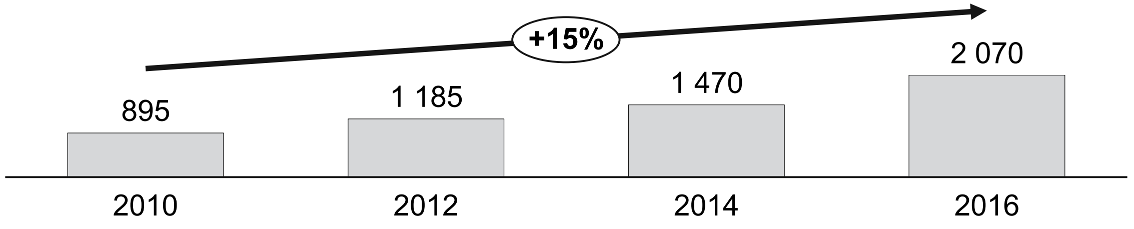
- The role of high speed rail in intercity travel is increasing

HSR TRANSPORTATION GROWTH

bln passengers - km



mln passengers



HSR COMPETITIVE ADVANTAGES

HSR vs Individual cars

(+)
- Privacy
- Full door-to-door trip
- Own choice of date and time
- Own choice of the route
- No tickets
- Car-pooling and car-sharing

(−)
- Not efficient over long-distances
- More inventive passenger services from HSR
- On-demand trains
- Fares based on the phone system
- Digital-oriented and multimodal market

HSR vs Air transport

(+)

> 5 hours	• HSR becomes a marginal actor compared to air
3.5 hours - 5 hours	• Air is the dominant mode

(−)

< 2 hours	• HSR dominates the market
2 hours - 3.5 hours	• HSR is the dominant mode
	• Access to city centers • Minimum access time

HSR vs Bus travel

(+)
- Low-cost service
- Offers several stops within a city
- Flexible pricing

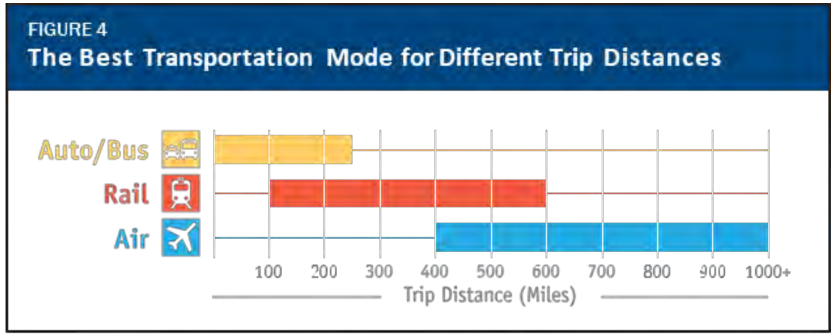
(−)
- Not efficient over long-distances
- ground speed
- access to city centers
- more freedom and passenger comfort on train board

Modal shares are driven by the relationship between the respective door-to-door travel times and level of passenger services available on board

Source: High Speed Rail Traffic 2017 - International Union of Railways

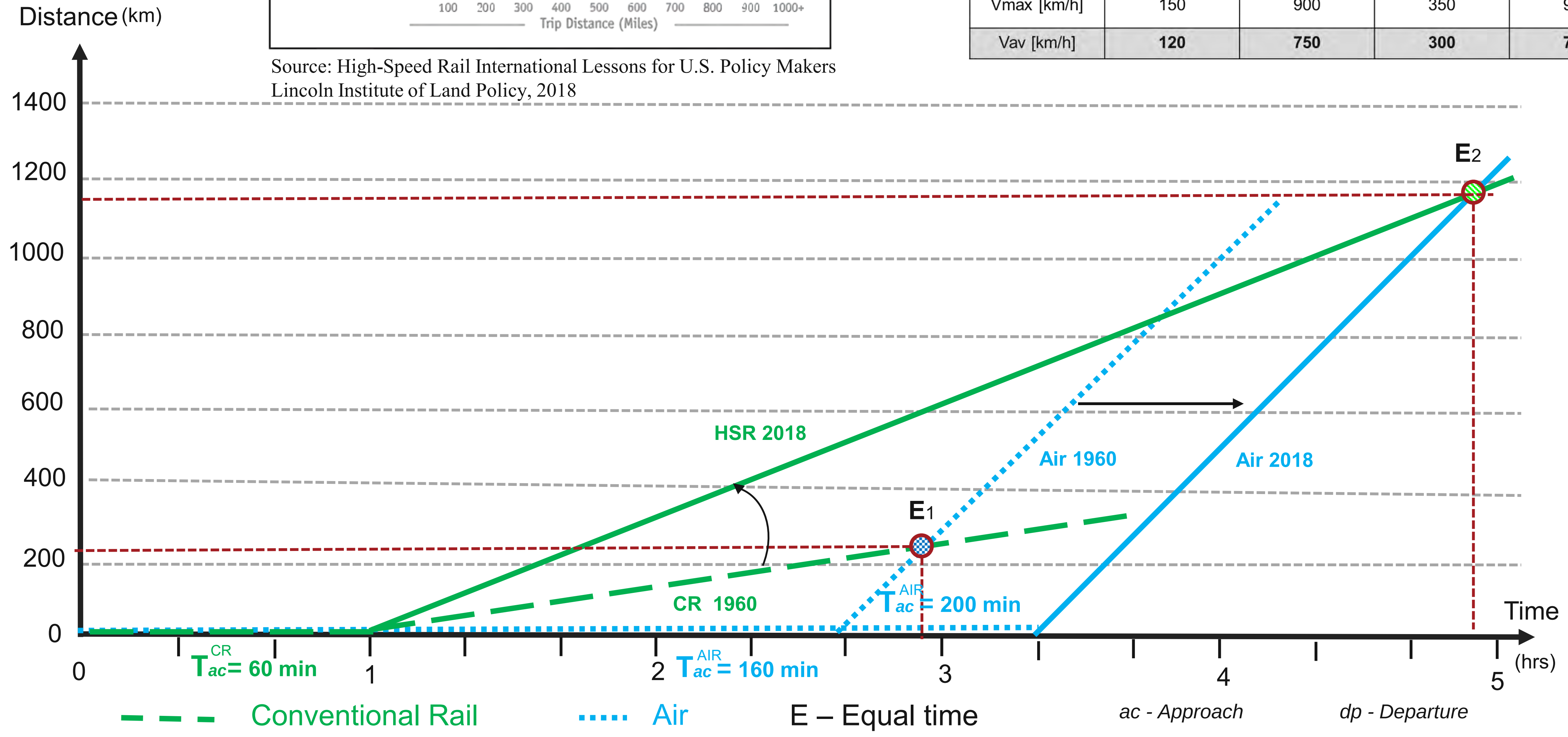
https://data.worldbank.org/indicator/IS.AIR.PSGR?end=2017&start=2000 https://uic.org/IMG/pdf/high_speed_passenger-km_20171130_.pdf
https://uic.org/IMG/pdf/uic_high_speed_2018_ph08_web.pdf

Comparison of travel times Conventional Rail and Air in 1960 and HSR and Air in 2018



Source: High-Speed Rail International Lessons for U.S. Policy Makers
Lincoln Institute of Land Policy, 2018

	1960		2018	
	CR	Air	HSR	Air
Tap [min]	40	120	40	160
Tdp [min]	20	40	20	40
Tac [min]	**60**	**160**	**60**	**200**
Vmax [km/h]	150	900	350	900
Vav [km/h]	**120**	**750**	**300**	**750**



Door-to-door travel time estimation outlines HSR mode[1] as the most convenient

	Starting location	Transfer of main means of transport		Main means of transport	Transfer to final destination		Final destination total time (HR)		Total cost
Conventional Rail	5 min	25 min	5 min	2h10	5 min	25 min	5 min	3h40	55 €
Bus	5 min	25 min	5 min	5h15	5 min	25 min	5 min	6h35	10 €
Automobile	7,5 min	0 min	0 min	5h15	0 min	0 min	7,5 min	3h30	65 €
Car-sharing / car-pooling	7,5 min / 5 min	0 min / 25 min	15 min / 10 min	3h15 3h15	15 min / 5 min	0 min / 25 min	7,5 min / 5 min	4h00 / 4h30	25 € / 20 €
Airline	5 min	50 min	45 min	1h05	30 min	50 min	5 min	4h10	120 €
HSR	5 min	25 min	5 min	1h25	5 min	25 min	5 min	2h55	55 €

Advantages of HSR

- ✓ Minimum time of access and egress
- ✓ Stations location in the city center
- ✓ Convenient integration with city transport
- ✓ Intermediate stops connect smaller cities
- ✓ Few and infrequent stations reduce travel time
- ✓ More on board passenger services and comfort

The most important growth driver of HSR growth is time-distance factor

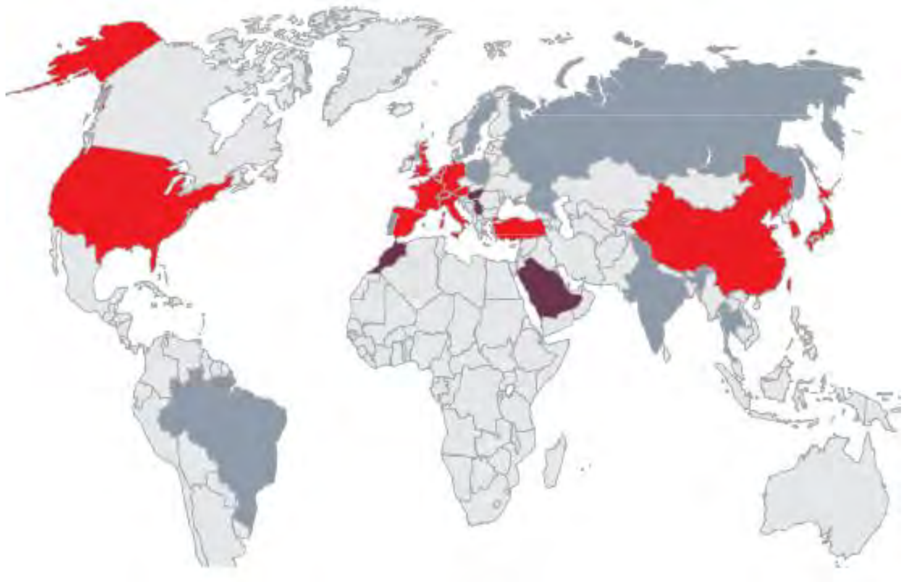
1 – considering the HSR travel time less than 3.5 hours

https://uic.org/IMG/pdf/20181001-high-speed-lines-in-the-world.pdf

Source: High Speed Brochure 2018 - International Union of Railways

43 thousand km of high speed rail are already in operation, almost 14 thousand km are under construction, almost 12 thousand km are planned

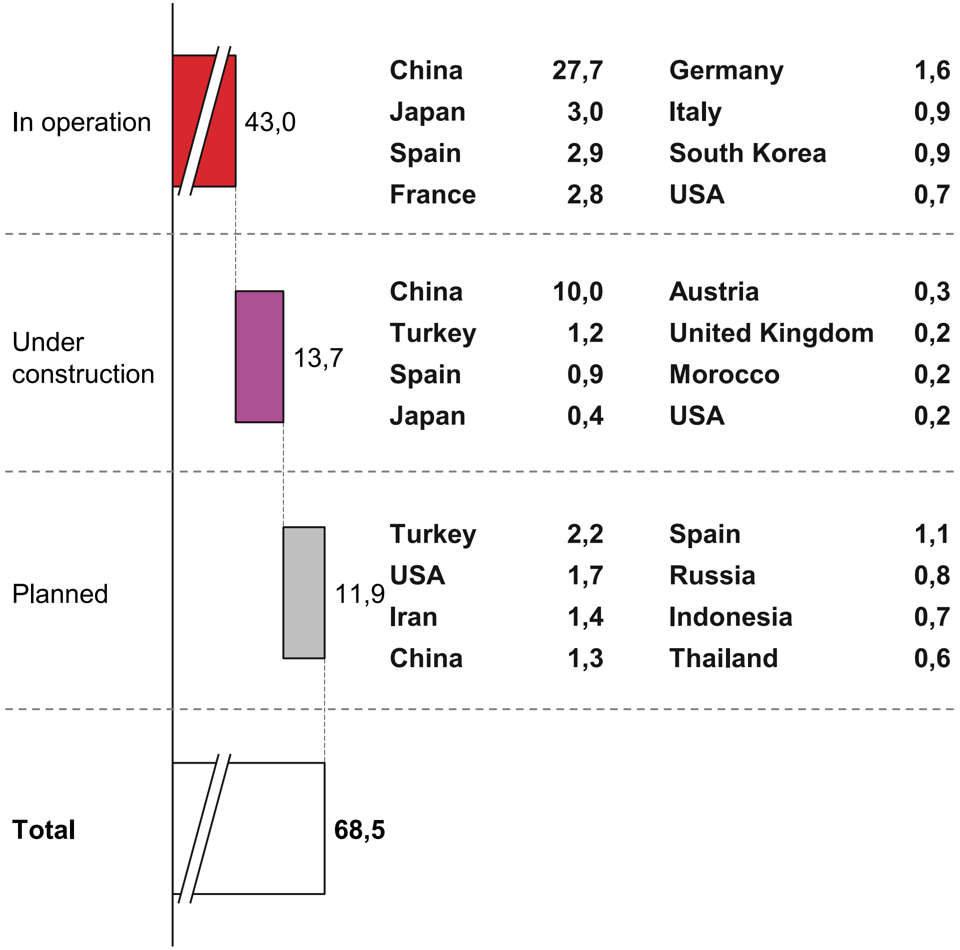
World HSR area coverage by types of readiness



> 1,6 bln. passengers annually

> 4 thousand HSR trains in operation

HSR length by time of readiness, thousand km



Source: High Speed Brochure 2018 - International Union of Railways, Russian Railways - 2018

http://www.hsrail.ru/info/vsmm/
https://uic.org/IMG/pdf/20181001-high-speed-lines-in-the-world.pdf

3. Operational Dissection and Performance Measure of HSR

Figure 3.1 Passenger access and travel time by station density

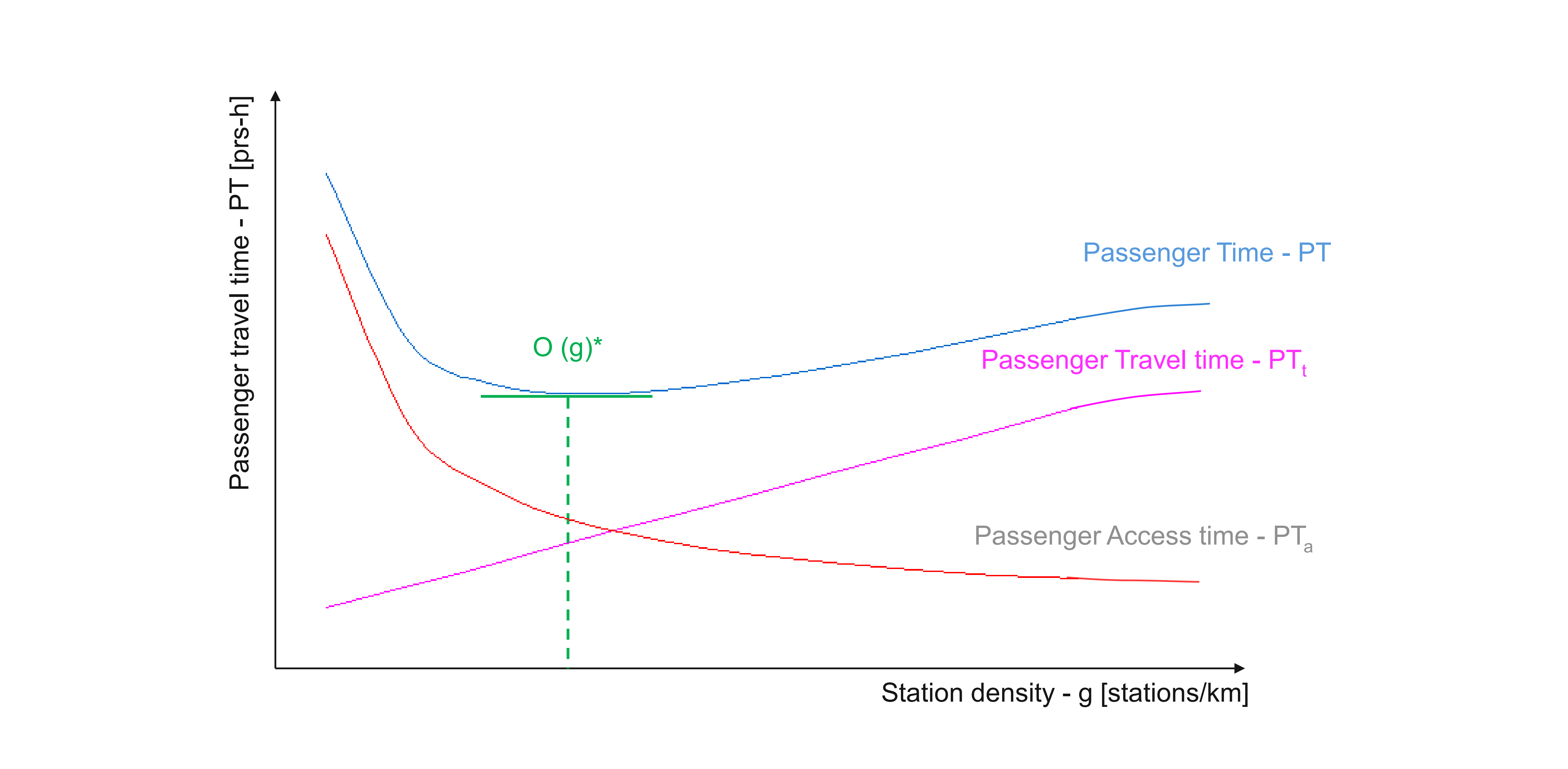


Figure 3.2 Station area coverage by density

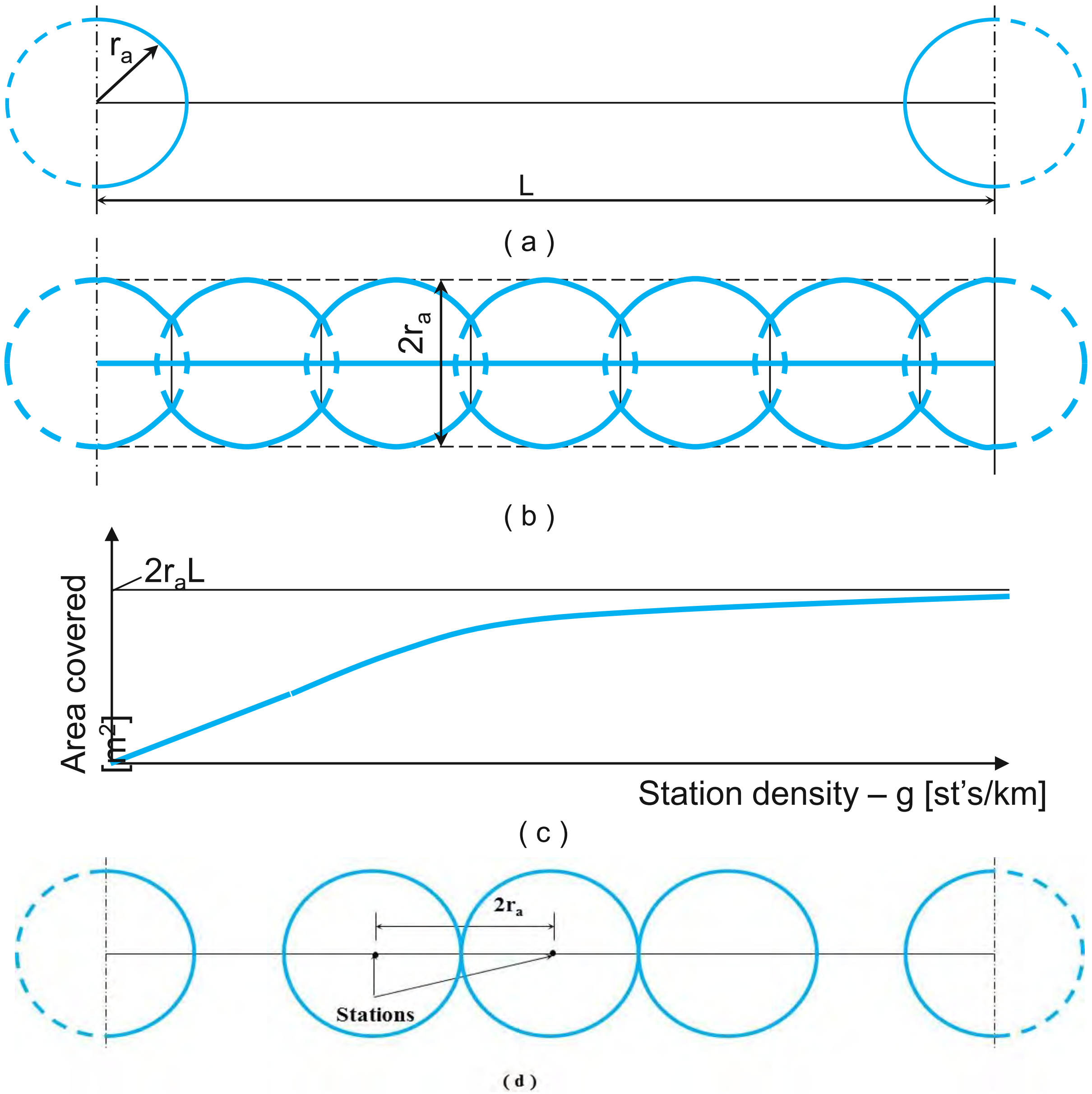


Figure 3.3 Travel disutility by station density and speed

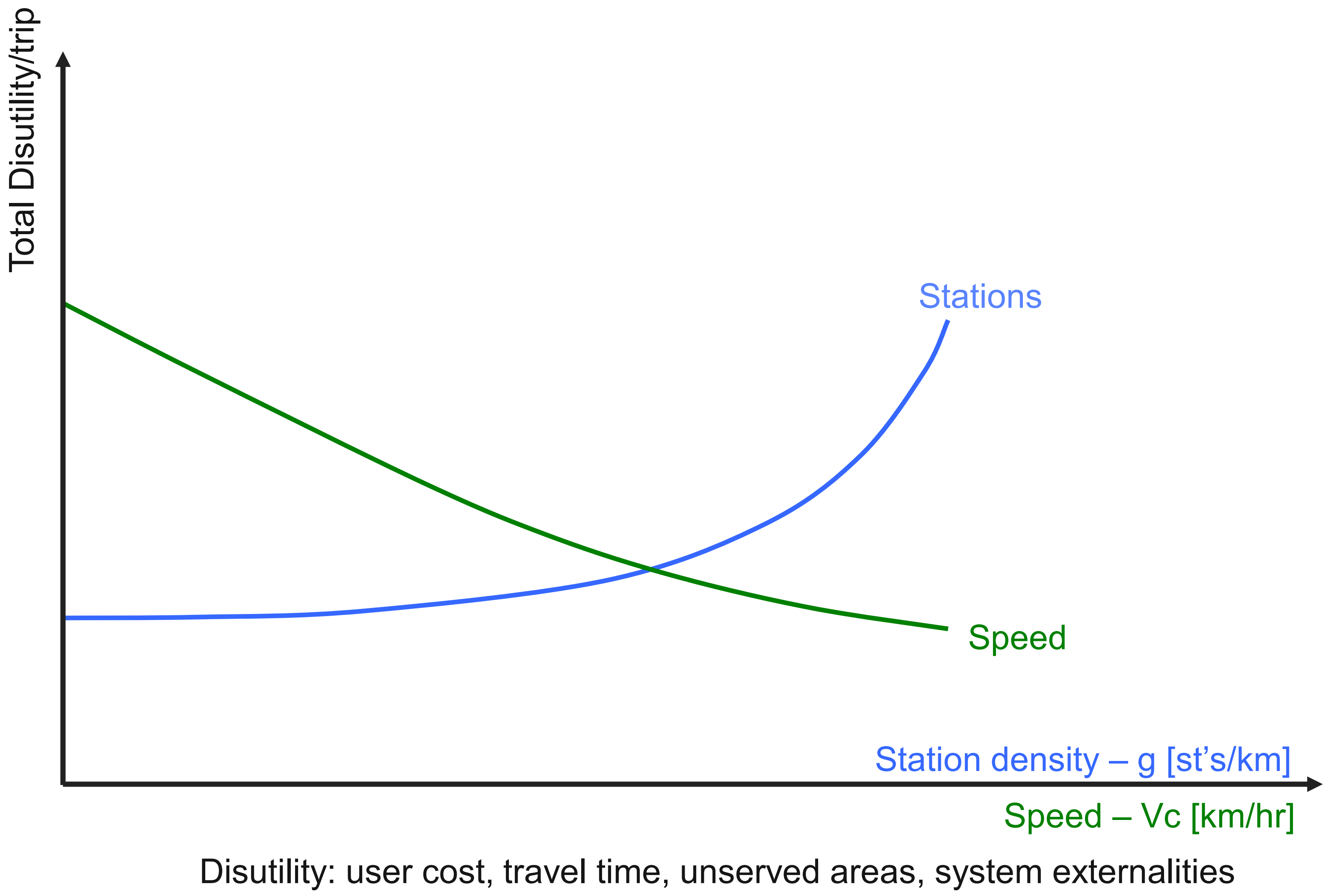


Figure 3.4 Travel distribution between station density and speed

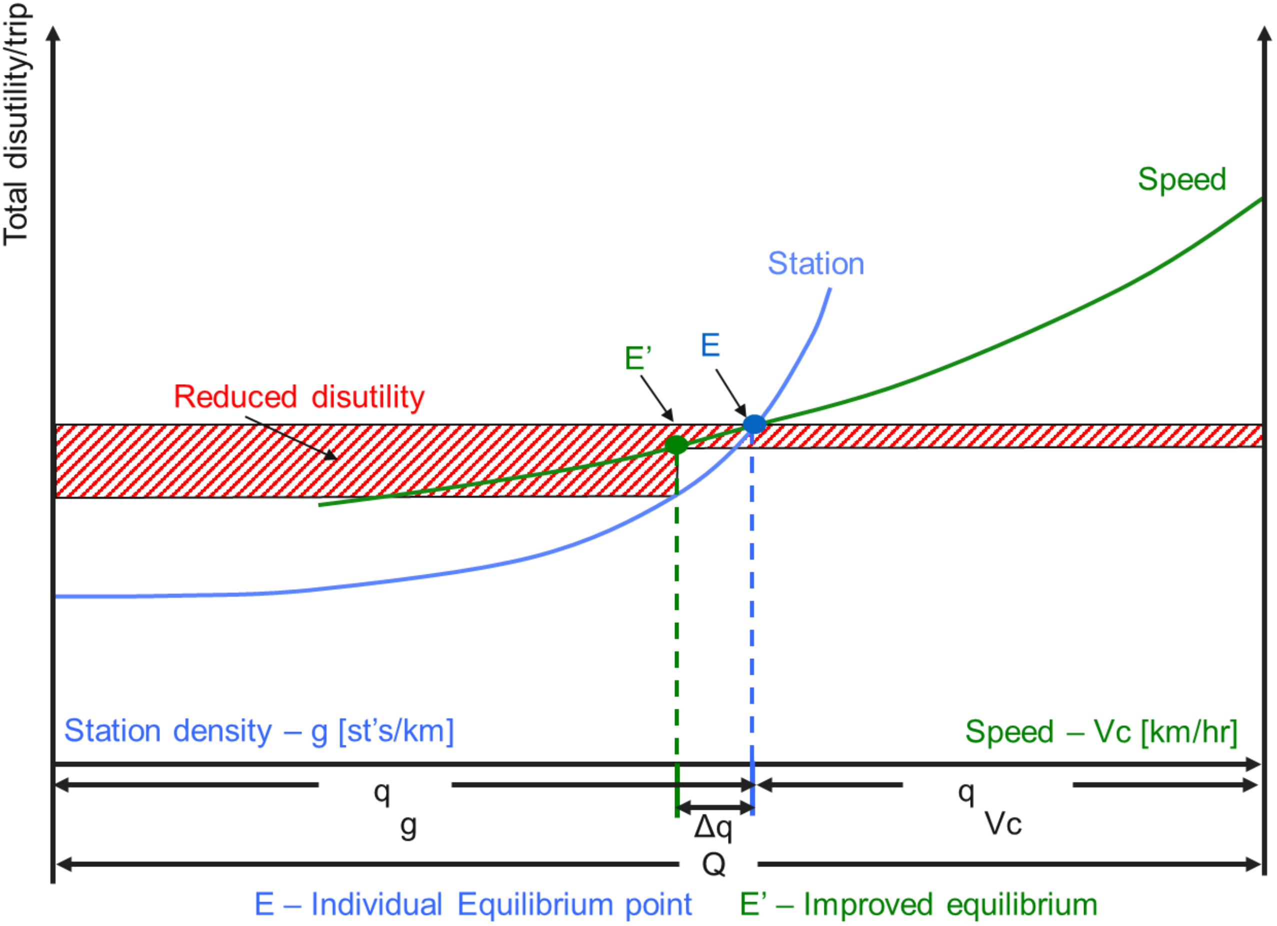


Figure 3.5 Operation strategy for shifting individual equilibrium to system optimum

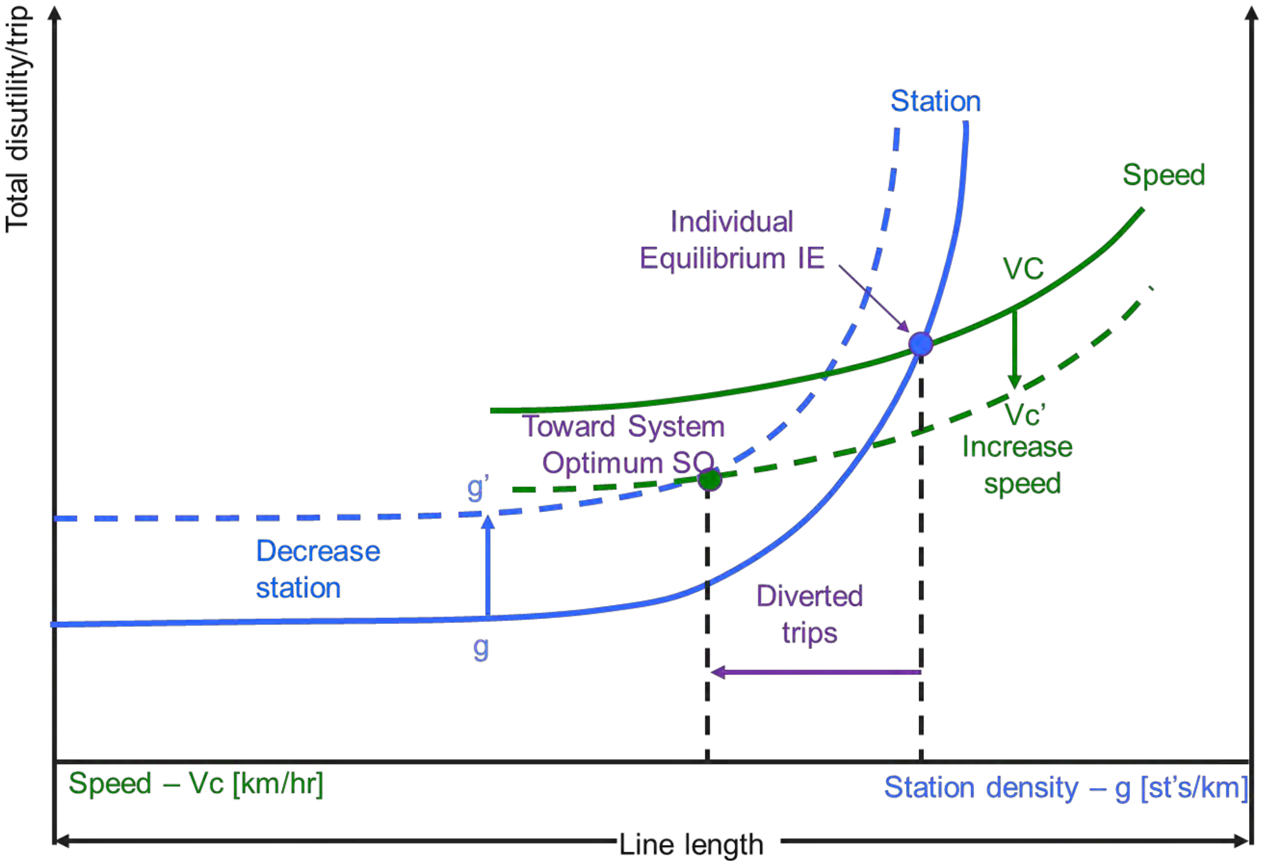


Figure 3.6 Evaluation on speed increase

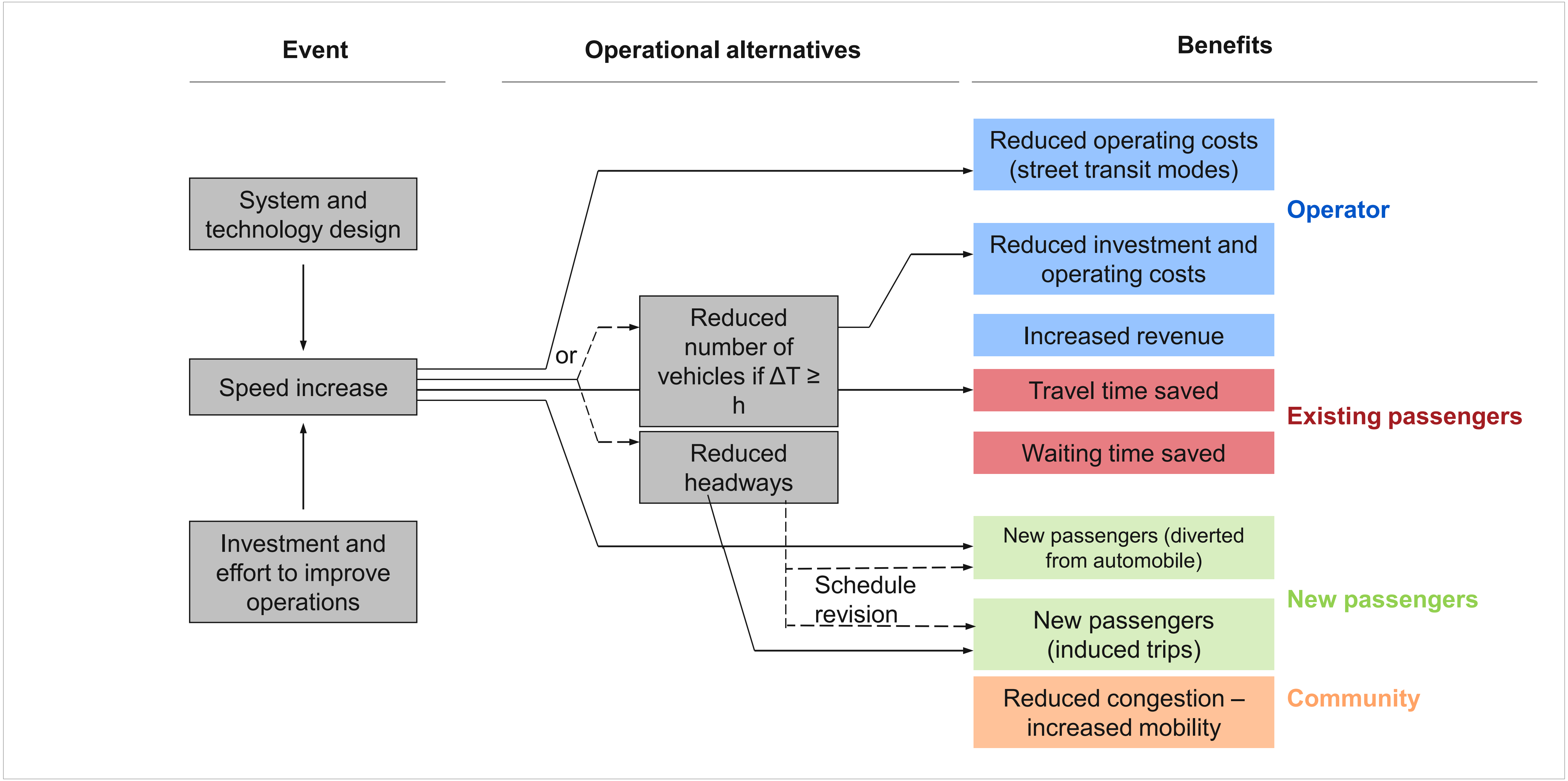
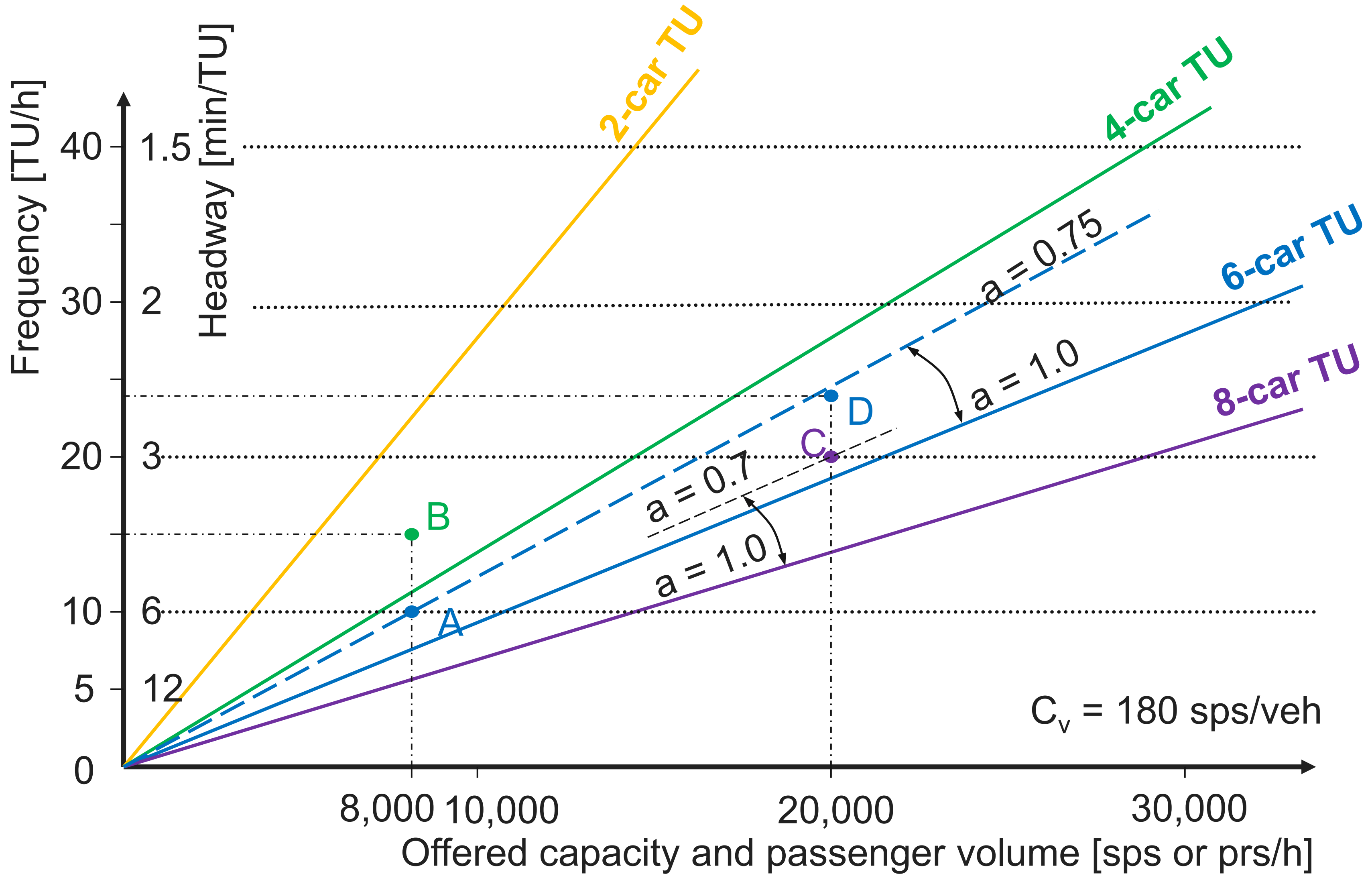
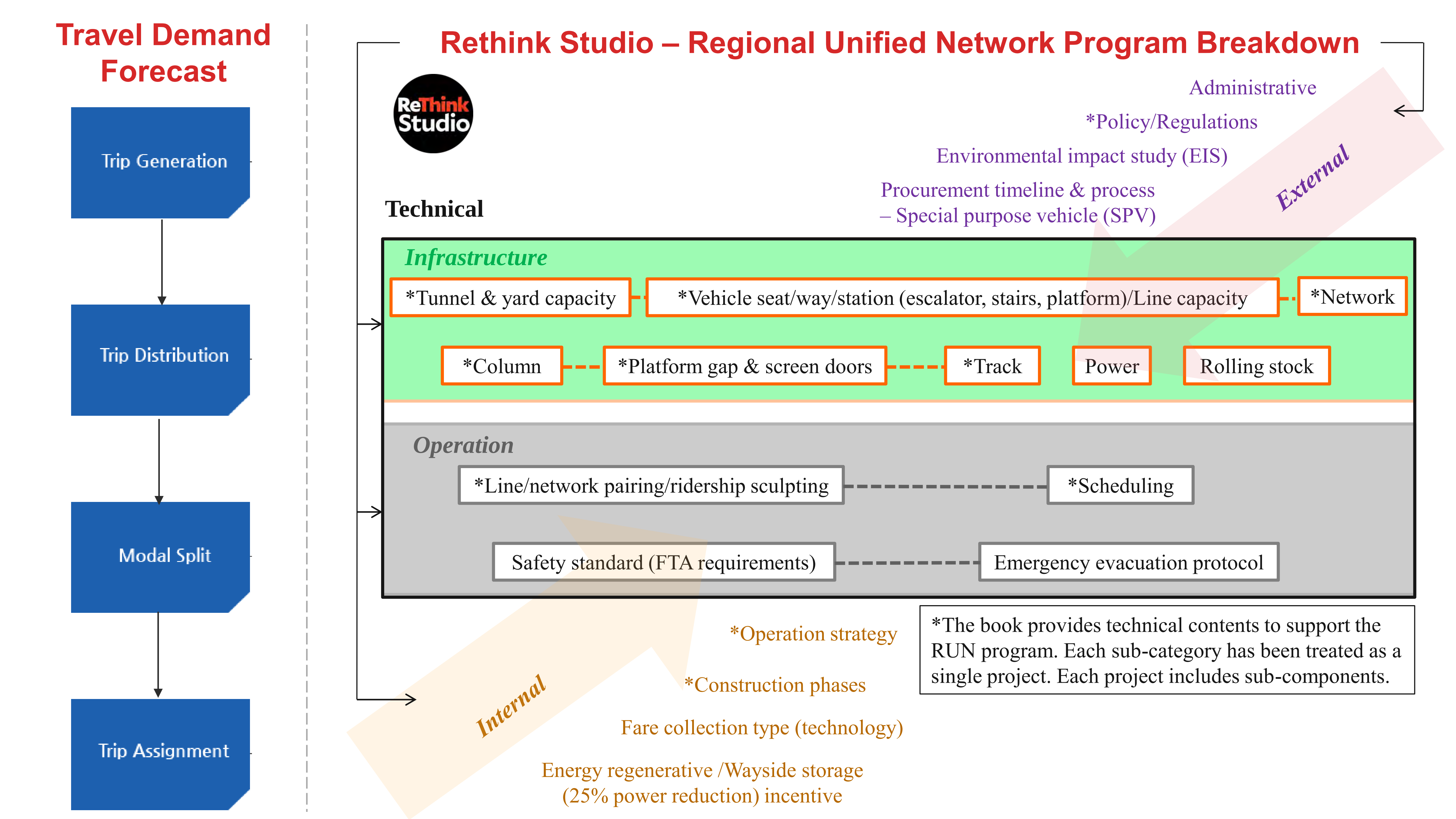


Figure 3.7 Transit unit capacity and headway on schedule design



4. A case study: New York Pennsylvania Station: Existing challenges and corresponding engineering measures



Travel Demand Forecast
Trip Generation
Trip Distribution
Modal Split
Trip Assignment
Rethink Studio – Regional Unified Network Program Breakdown
ReThink Studio
Administrative
*Policy/Regulations
Environmental impact study (EIS)
Procurement timeline & process
– Special purpose vehicle (SPV)
External
Technical
Infrastructure
*Tunnel & yard capacity
*Vehicle seat/way/station (escalator, stairs, platform)/Line capacity
*Network
*Column
*Platform gap & screen doors
*Track
Power
Rolling stock
Operation
*Line/network pairing/ridership sculpting
*Scheduling
Safety standard (FTA requirements)
Emergency evacuation protocol
*Operation strategy
*Construction phases
Fare collection type (technology)
Energy regenerative /Wayside storage
(25% power reduction) incentive
Internal
*The book provides technical contents to support the RUN program. Each sub-category has been treated as a single project. Each project includes sub-components.

New York City Regional Transit Plan 2050

NY-NJ-CT Tristate Transit Plan 2050

Existing situation: Low capacity mode for intercity passenger travel

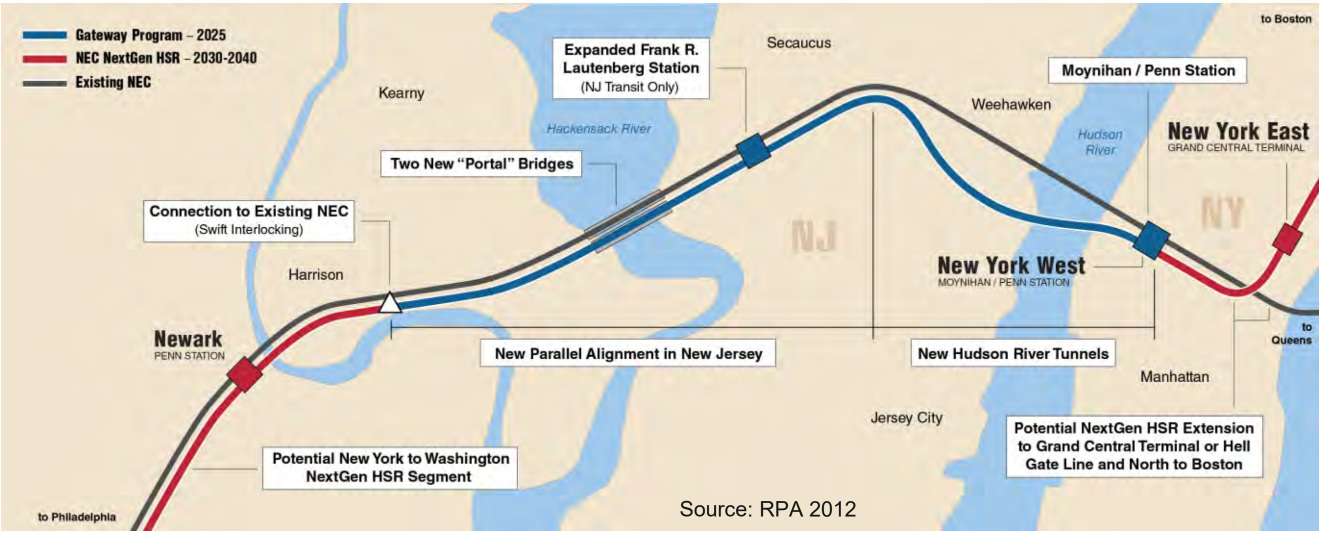
Aerial footage on Lincoln tunnel (NY-NJ bidirectional)

Source: Wikipedia[1], New York Business Journal[2], CBS[3], NBC New York[4]

NY-NJ Gateway Tunnel Project

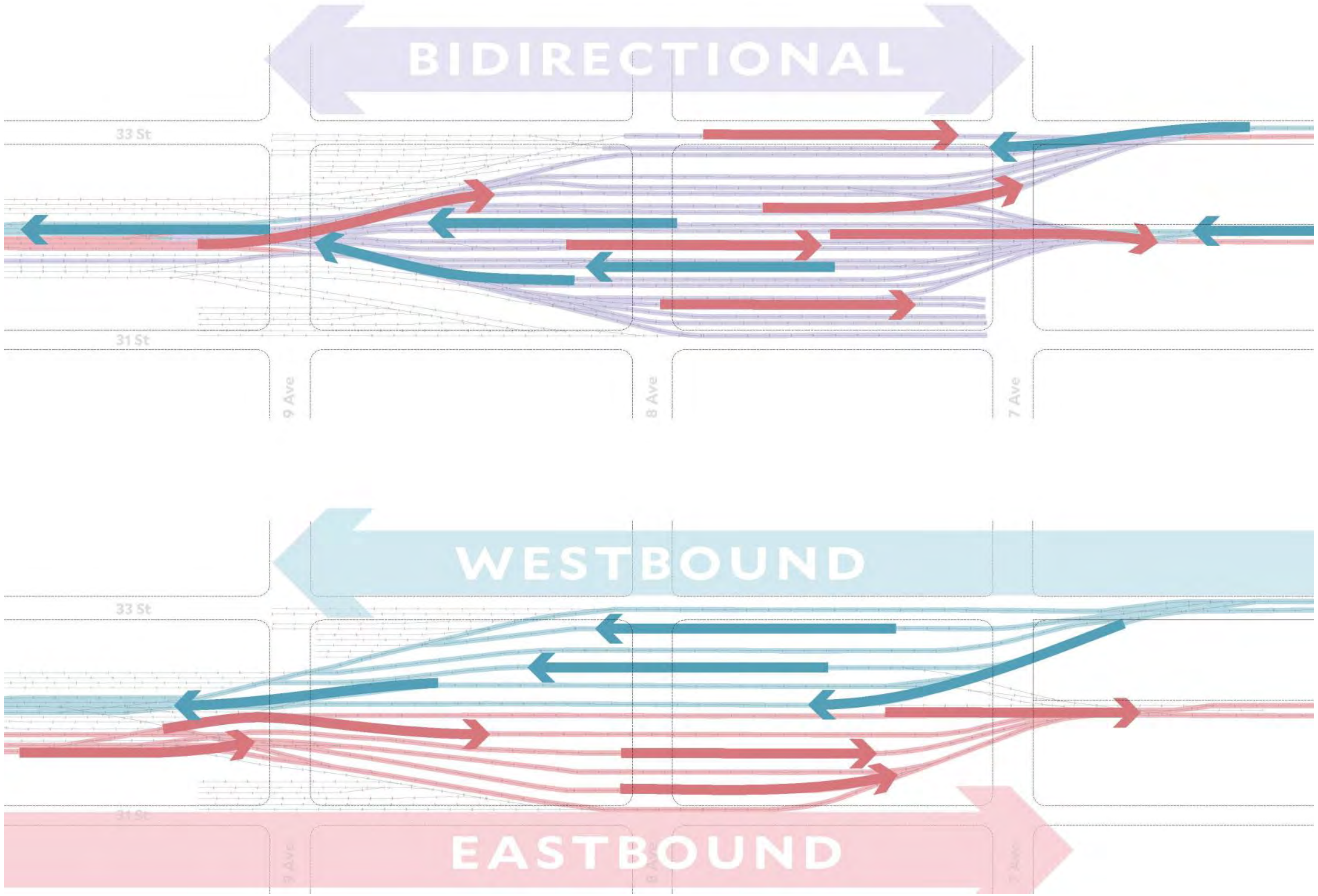
NY-NJ Gateway Tunnel
(Opened in 1937 & 1954)

Trump administration cut $4BN budget to the tunnel project in FY2018



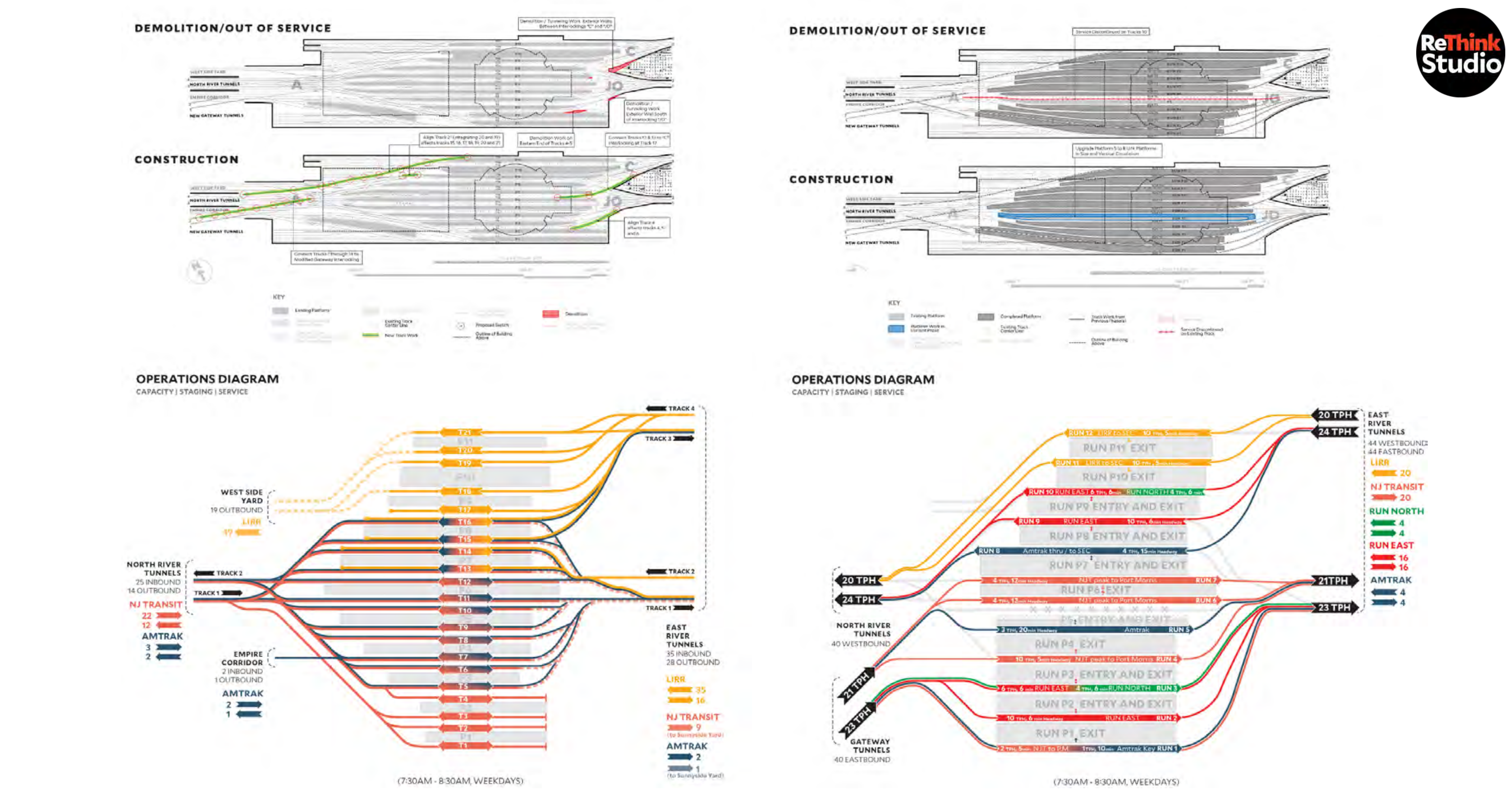
Source: RPA 2012

Figure 4.1: Low Network Capacity (Up) vs. Flexible Track Alignment for Higher Operation (Down)



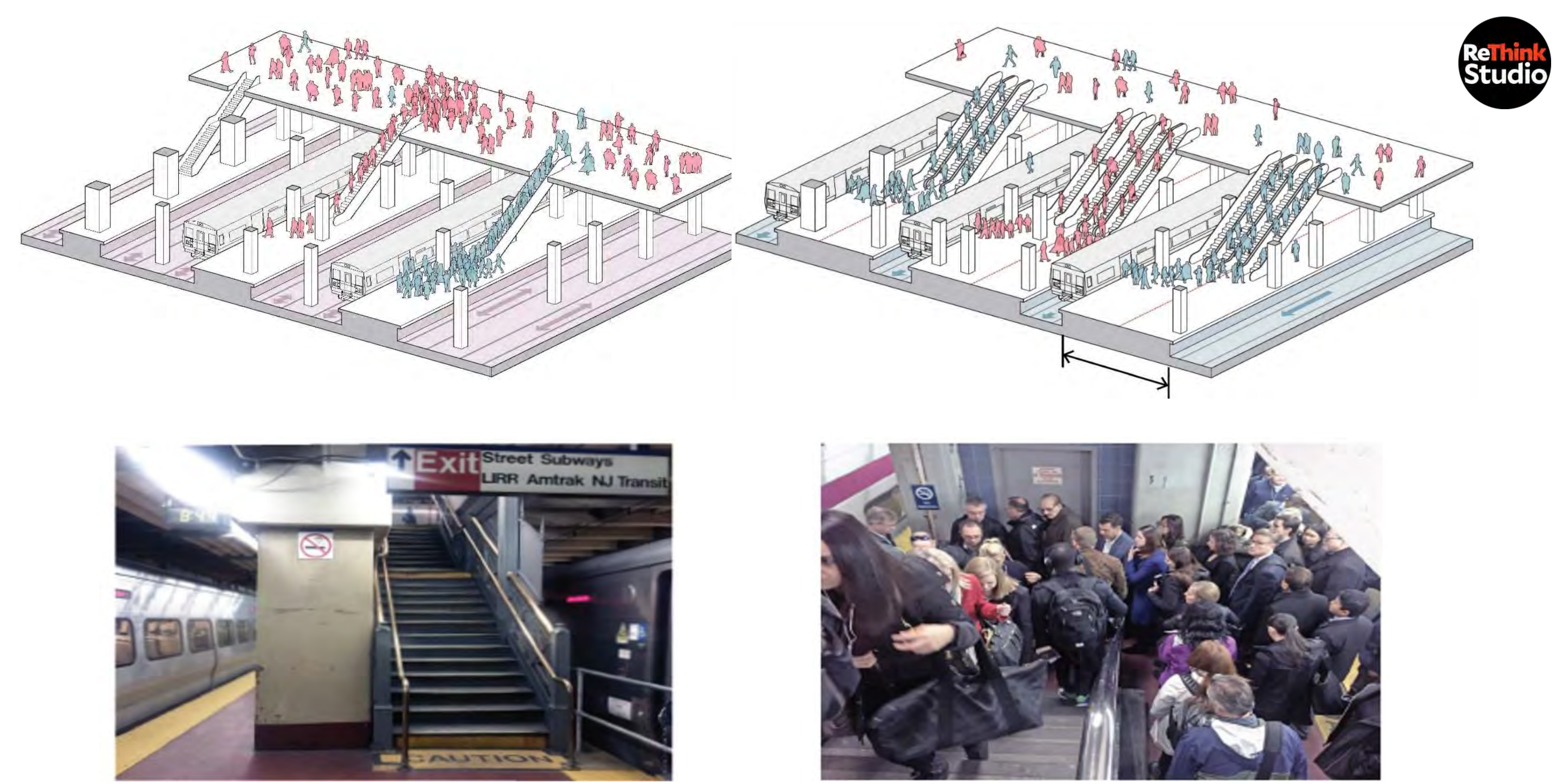
NY Pennsylvania station Dead-end conflict (Up) vs. Through-running flow (Down)

Figure 4.2 Operation efficiency: increase of tunnel and track utilization



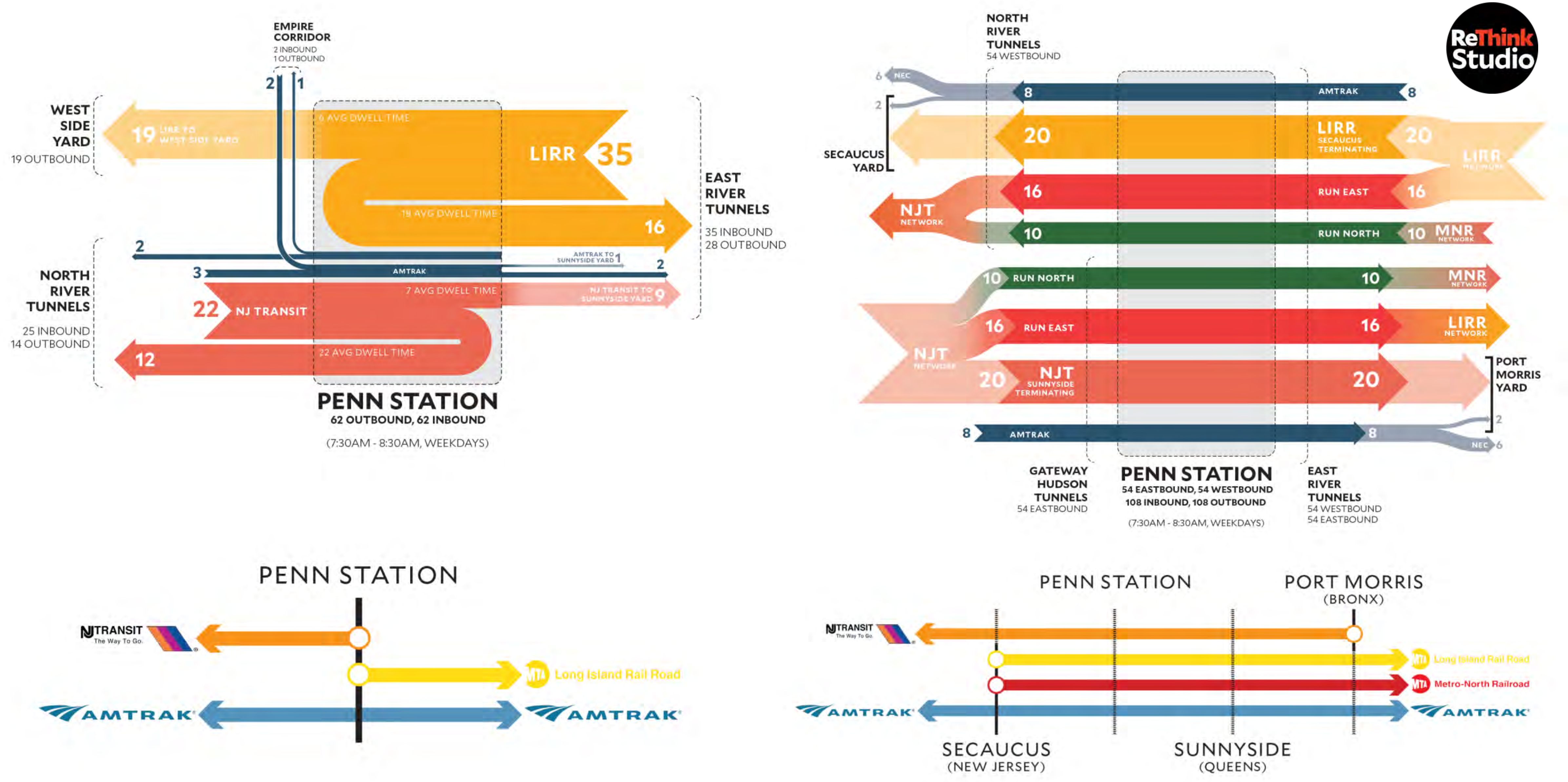
Selected schematic design on track reengineering, network realignment (Left) and counter operation strategy (Right) within the Penn station construction phasing Plan

Figure 4.3 Limited Passenger Circulation vs. Platform Expansion to Expedite Boarding and Alighting Process



Penn Station existing platform condition (Upper-left and lower two) vs. Engineering improvement on vertical circulation (Upper-right).

Figure 4.4 Disconnected Network Services vs. Unified Network to Increase Regional Connectivity



Comparative analyses of dead-end (Left) vs. through-running (Right) network capacity at the New York Pennsylvania Station

5. Russia HSR Case Studies and Future Networks

Dr. Vuchic and Deputy Mayor of Moscow
Mr. Maksim Liksutov

Russia Federation Broadcast Interview

Exclusive meeting with Dean of St. Petersburg State University Dept. Transport along with Rethink Studio (Sept 2018)

Moscow Metro

High speed rail in Russia

«SAPSAN» (eng. «Sapsan»)
Moscow – St. Petersburg

- Type: **Siemens** Velaro
- Operation **since 2009**
- Average speed – **180 km/h**
- **15** times a day
- **2-3 stops**

635 km
distance

3h40
Travel time

32.2 mln
total passengers since its launch

«ALLEGRO»
St. Petersburg - Helsinki

- Type: **Alstom**
- Operation **since 2010**
- Average speed – **120 km/h**
- **8** times per day
- **5-7 stops**

407 km
distance

3h27
Travel time

2.3 mln
total passengers since its launch

«STRIZH» (eng. «Martin»)
Moscow – Nizhniy Novgorod

- Type: **Talgo** TransMashHolding
- Operation **since 2015**
- Average speed – **130 km/h**
- **5 times a days**
- **5-7 stops**

442 km
distance

3h35
Travel time

1.9 mln
total passengers since its launch

«LASTOCHKA» (eng. «Swallow»)
Connects cities Moscow, St Petersburg, Sochi, Krasnodar, Yekaterinburg, Kaliningrad, Rostov-on-Don with other regional towns

- Type: **Siemens Desiro**
- Operation **since 2013**
- More than **170 trains** on different routes
- 5-7 times a day
- 2-10 stops

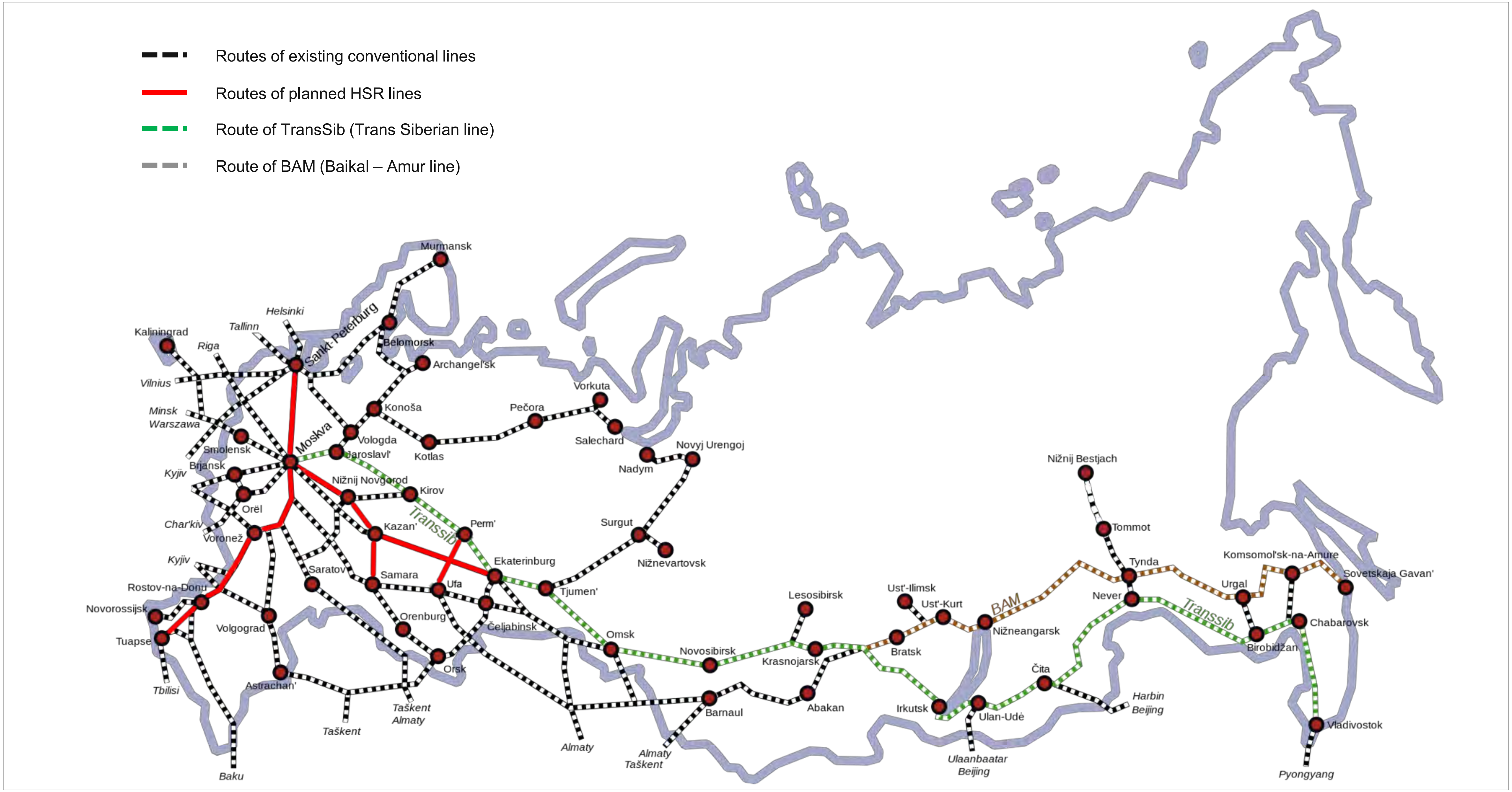
100-500 km
distance

25 min – 6h
Travel time

9.2 mln
total passengers since its launch

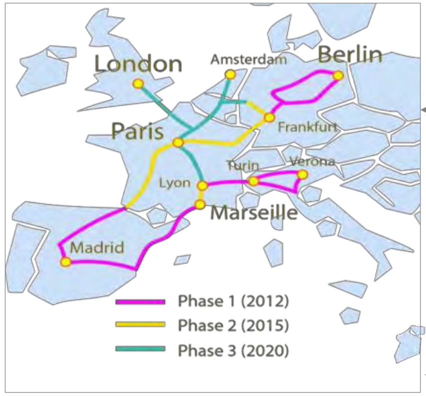
Source: Russian Railways

Railway network in Russia

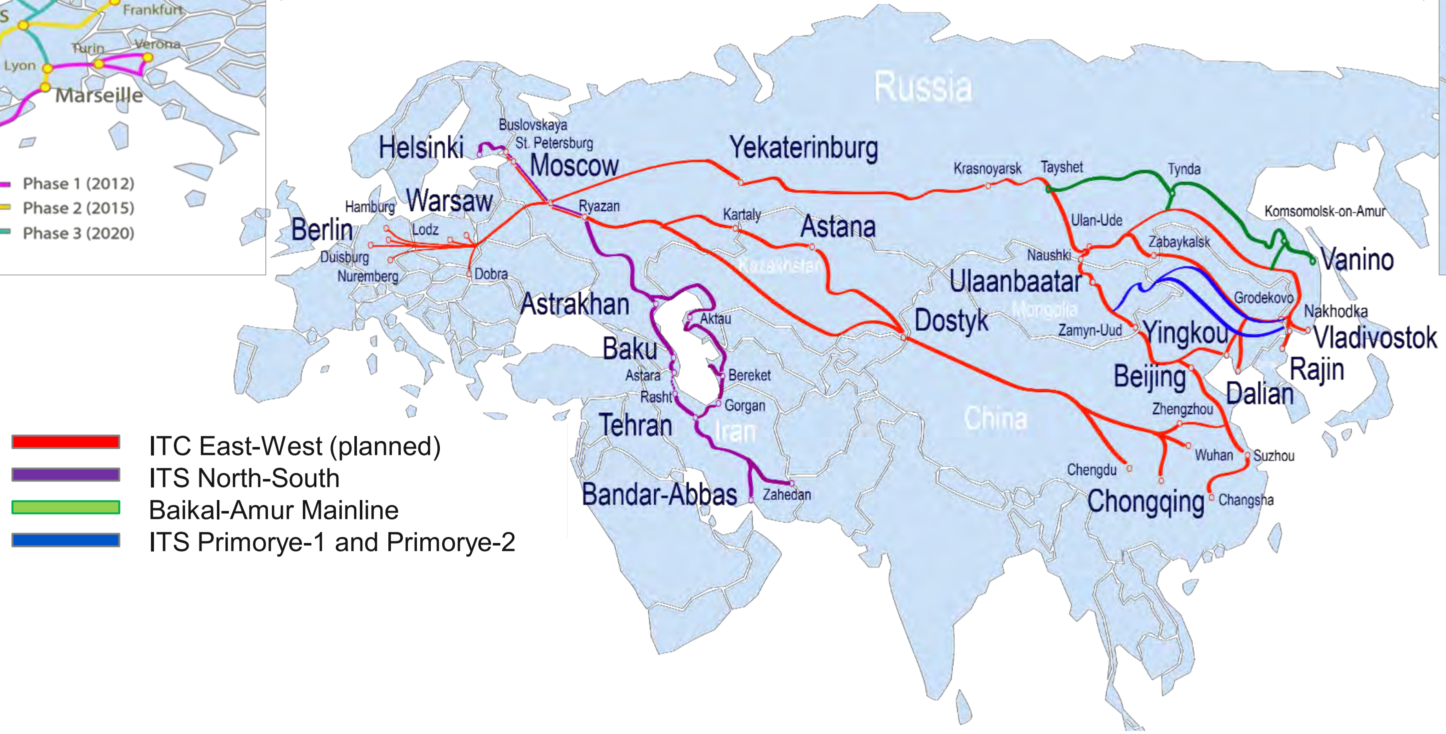


Planned HSR «Eurasia» – is a corridor, connecting Chinese and European HSR networks through the Russian HSR network

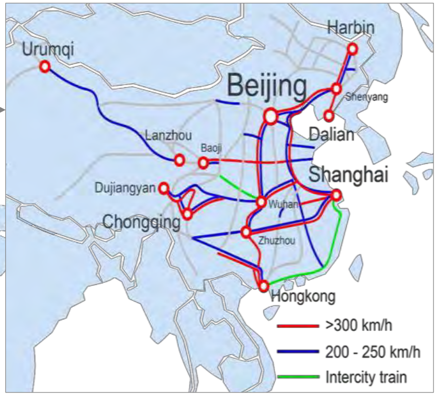
Euro Carex



HSR in Russia will connect major HSR systems into the HSR Eurasia



China High Speed Train Network



9500 km
Total HSR length from Europe to Beijing

7700 km
HSR length from Moscow to Beijing

2300 km
HSR length across Russia

30 h
Travel time from Moscow to Beijing

Travel time from Moscow to Beijing by railway is reduced to **32 hours** - by **4 times**
Desirable delivery period for a potential customer is **3-5 days**

Source: Russian Railways http://www.hsrail.ru/info/silkway/

HSR-1 project: HSR Moscow - St. Petersburg

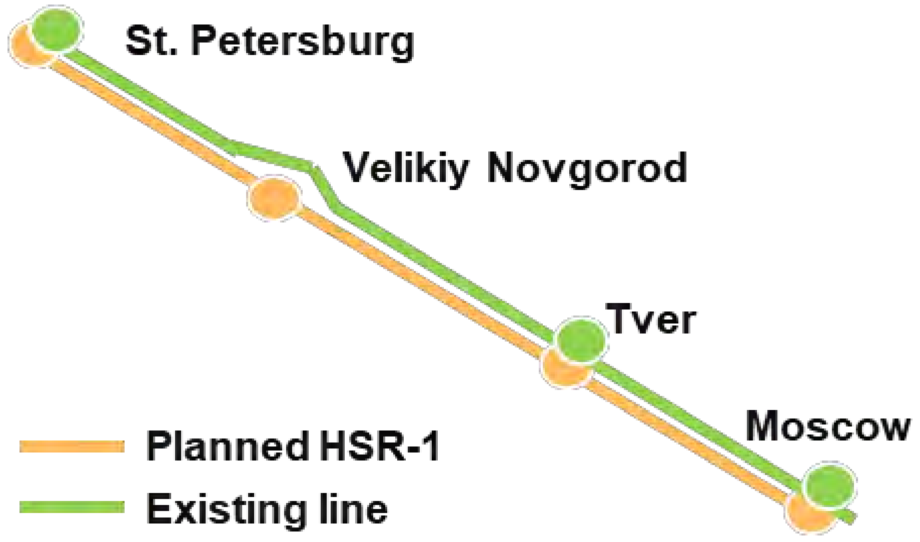
- The Program enables more than **50 express routes**
- Total length of HSR and SR lines will exceed **7 thousand** km
- More than **70% - 100 mln** people live in the catchment area

1595 km
HSR length to Yekaterinburg

8h
Travel time from Moscow to Yekaterinburg

Source: Russian Railways

HSR-1 project: HSR Moscow - St. Petersburg



HSR in operation on the existing line

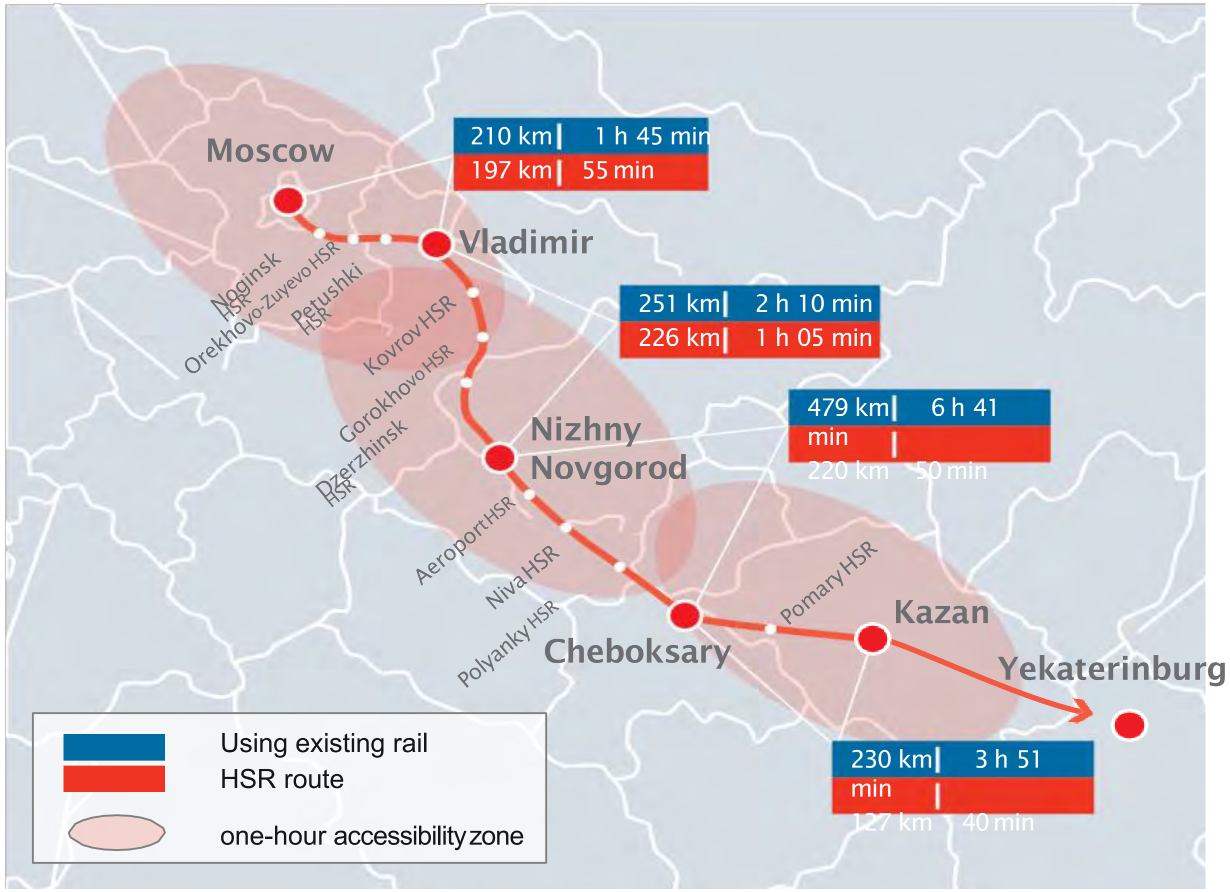
- Idea rose in **1960-s**, a trial operation was tested
- Research work and testing done in **1969 – 1974**, signalling system was upgraded
- First high speed trains **ER-200** launched in **1984**
- New high speed **SAPSAN** trains launched in **2009** and still operate
- Travel time – **3h35**, distance **15 trains** per day

HSR-1 on new planned line
(30 km remote from the existing line), lies through Velikiy Novgorod

- **1988** – feasibility study, **1992** – design and project documentation approved by the Expertize
- **2006** - establishment of JV «High Speed Railways»
- **2013** – approval of the President to build the HSR
- Procurement of **20** French **ALSTOM** trains
- Length – **640 km,** Travel time – **2h30**
- Maximum speed – **400 km/h,** Frequency – **42 trains** per day, Traffic forecast – **14 mln** passengers annually

Source: Russian Railways

HSR-2 project: new high speed line from Moscow to Kazan



Railway location

- Moscow, Moscow Region, Vladimir Region, Nizhny Novgorod Region, Chuvash Republic, Mari-El Republic and the Republic of Tatarstan

1st stage of the construction

- Launch planned in 2024
- A part of HSR line of 301 km length
- Will connect Zheleznodorozhnyi town in Moscow Region with Gorokhovetz in Vladimir Region

Total travel time

Moscow-Kazan	14 h 07 min	3 h 30 min
Moscow-Nizhny Novgorod	3 h 55 min	2 h 00 min
Nizhny Novgorod-Kazan	10 h 32 min	1 h 30 min

3h30
Travel time From Moscow to Kazan

770 km
Length of line From Moscow to Kazan

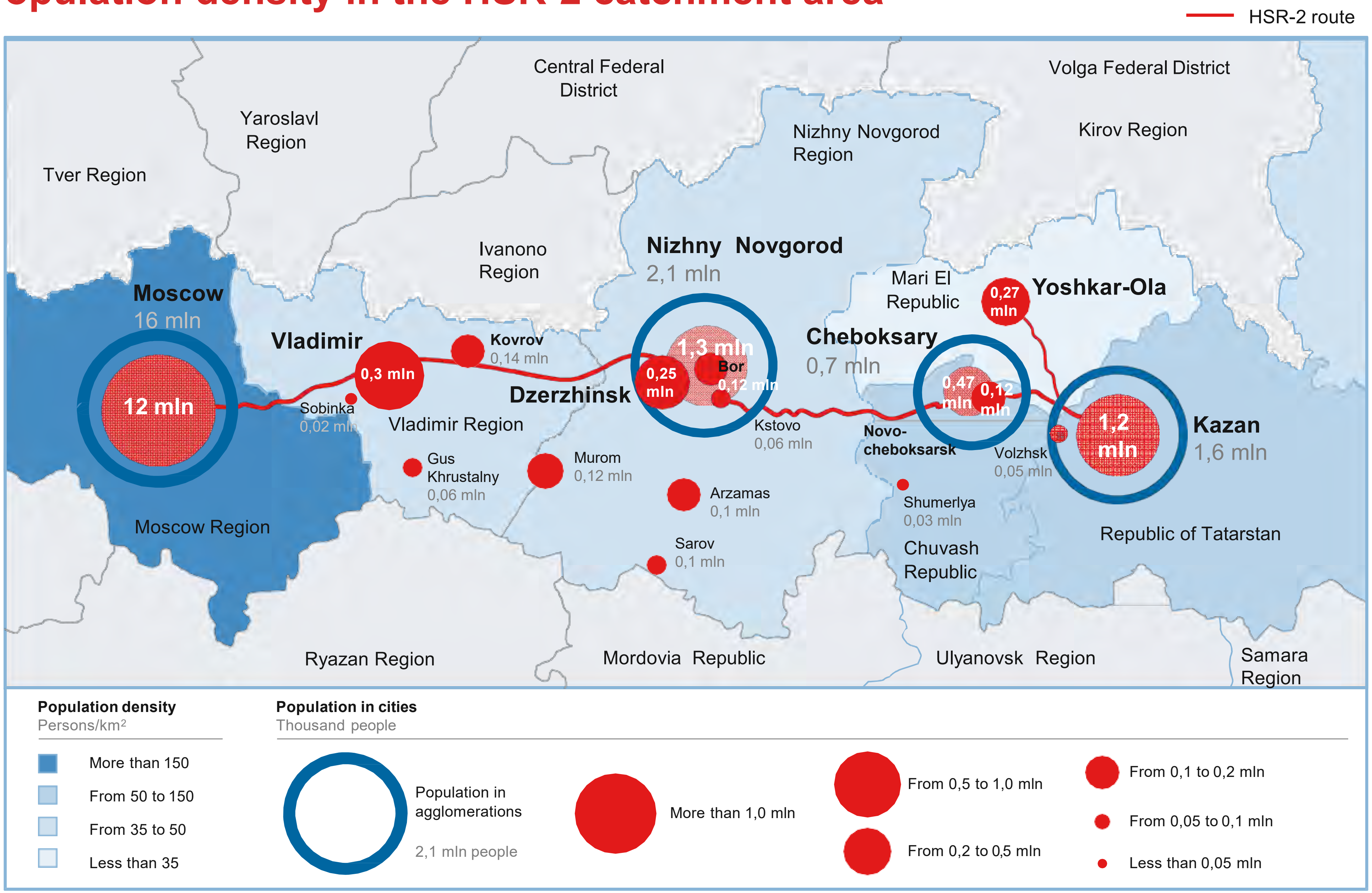
4-fold
Reduction in journey time

10.5 mln
Annual passenger flow

350-400 km/h Speed

Source: Russian Railways

Population density in the HSR-2 catchment area



Source: Russian Railways

Existing agreements on Moscow – Kazan HSR

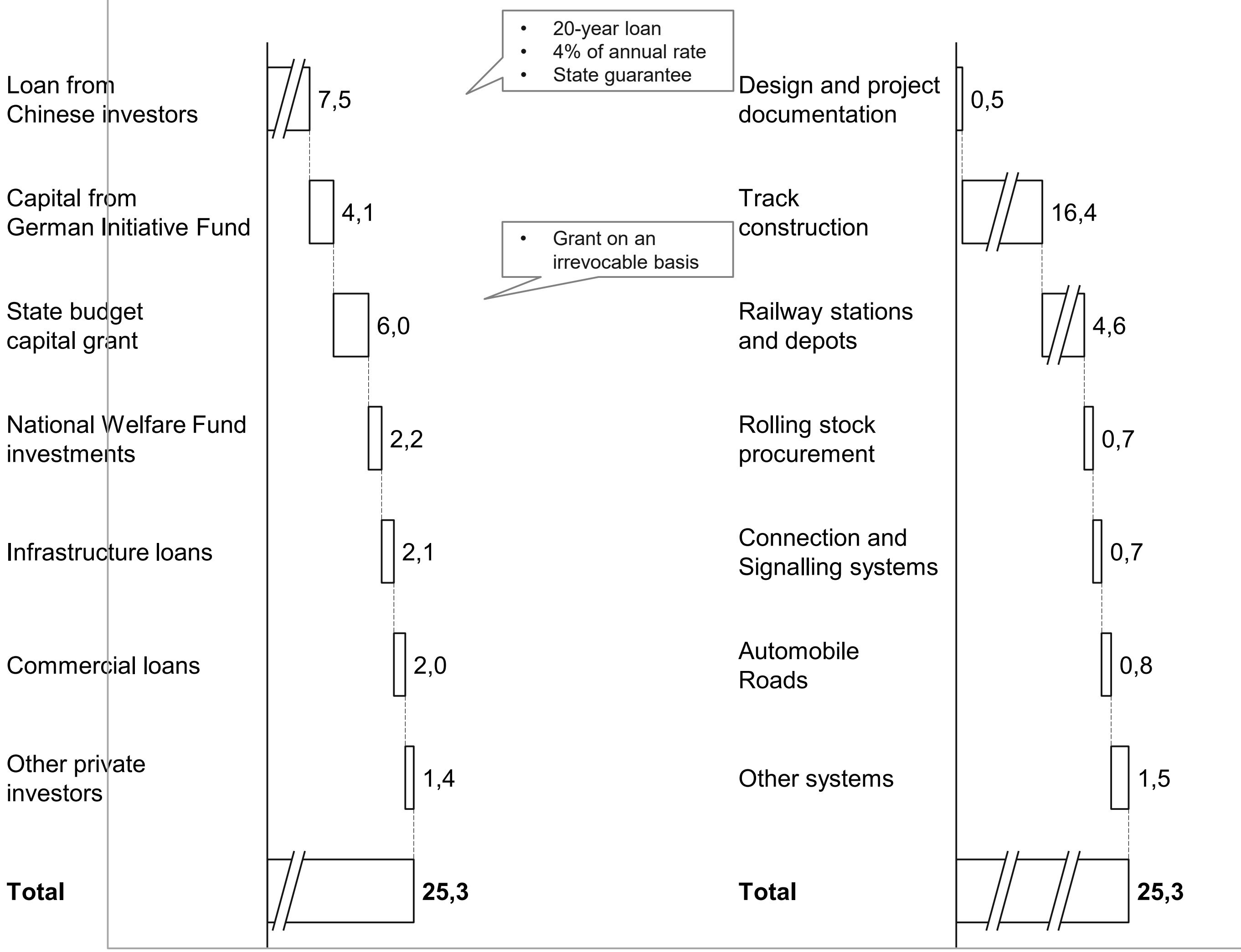
Stages	Counterparties and agreements	Subject	Status
PROJECT ORGANIZATION	Russian Railways, China Railways, Ministry of Transport of Russia, State Committee for Development of China	• Moscow – Beijing Eurasian HSR transport corridor development • Roadmap for Chinese-Russian cooperation	Memorandum of cooperation for the HSR construction signed in October 2014
	Russia and China	• Agreement on using Chinese technologies while constructing the HSR line with Russian companies participation	Memorandum of cooperation for the HSR construction signed in May 2015
DESIGN	Russian High-Speed Railways, Mosgiprotrans, China Railway Eryuan Engineering Group Co. Ltd In total, over 50 entities, including Russia's leading design	• Joint project and design documentation development, timeline, territory preparation for the construction	Contract amounting $400 USD signed in May 2015
	Russian Railways and Russian High-Speed Railways, Systra, SNCF	• Engineering research, project documentation of construction of the first site of the highway Moscow – Nizhny Novgorod development	End of 1 work phase in 2016
FINANCE & CONSTRUCTION	Eurasian Development Bank (EDB) [1] and Russian Railways	• Finance arrangement and capital contribution to the SPV • Fund rise from international investors	Agreement signed in May 2018
	Potential Investors - Russian Direct Investment Fund, BRICS New Development Bank, Silk Road Fund and Russia-China Investment Fund, Infrastructure Fund of the Russian Federation	• OHL (Spain), Bouygues, Systra, SNCF, Vinci (France), Salini (Italy) showed interest in participating in the constrcution of the HSR	Negotiations since March 2014
	China Development Bank	• Interest shown to the project concerning the extension of the HSR line to Beijing	Negotiations since September 2014
	Pension Fund of Russia National Welfare Fund of Russia	• Finance arrangement	Preliminary precontractual discussion
	Russian Metals and Mining companies		Preliminary precontractual discussion
ROLLING STOCK	Russian Railways, Sinara Group, Siemens, Alstom, China CNR Corporation	• Definition of technical requirements to the rolling stock • Agreement on the rolling stock purchase: 11 trains (27 cars) and production localization in Russia • Transfer of technologies to "Ural Locomotives"	Preliminary precontractual discussion

1 - Eurasian Development Bank (EDB) - *founded by Russia and Kazakhstan in January 2006 with the mission to facilitate the development of market economies, sustainable economic growth, and the expansion of mutual trade and other economic ties*

Total investments in a project Moscow – Kazan HSR equal $25.3bn USD

Project financing by sources, bln USD

Investment projects, bln USD



PPP-Concession agreement

State	Concessionaire
Transfer of land plots to the concessionaire for the construction	Whole cycle of construction
Subsidy for operation and loan payment is given on annual basis	Operation after the launch

Construction peculiarities

- Implementation of Chinese technologies
- **85%** of production localization in Russia

Key financials [1]

$6.0 bn State budget capital grant	**$6.0 bn** State budget capital grant
4.8% Average profitability	**22.5 years** Payback period

1 - according to the investment model of Russian railways, Russian transport strategy 2030

HSR-2 construction leads to increase in spillover effects

Passenger comfort

- Multimodal transport systems development
- Seamless passenger transit
- Unified fare system – cost reduction for the passenger
- Integration into city transport – unified navigation and schedule time
- Safety of travelling
- Unified service and technology space – unified online service

Seamless trade

- Rapid growth of e-commerce from China to Europe

Population mobility

- Increase in mobility – work travelling, tourism
- Integration of large cities into one agglomeration – more than **20 mln** people
- Territory coverage – **15 %**

Economy boost

- Additional tax income into the regions budgets
- Newly created jobs – **370 thousand**
- Increase in budget income – **$61 bln USD** during the forecasted period 2026-2036 by agglomeration effects
- Additional investments into **local industries** – heavy industry, mechanical engineering, scientific developments (Ural Locomotives, Mechel), manufacturing industry
- Estimated Trans-Siberian Cargo turnover **by 2 times**

230 min
Total travel time Moscow - Kazan

354 tons
Of metal required for the construction of the HSR

$ 193 bln
Aggregate GRP increase

370 th
New created jobs

$174 bln
Estimated GDP increase till 2030

48 th
People involved in construction works

** Source: Moscow Metro, Russian Railways*

Moscow – Kazan HSR comparison to other world high speed railways

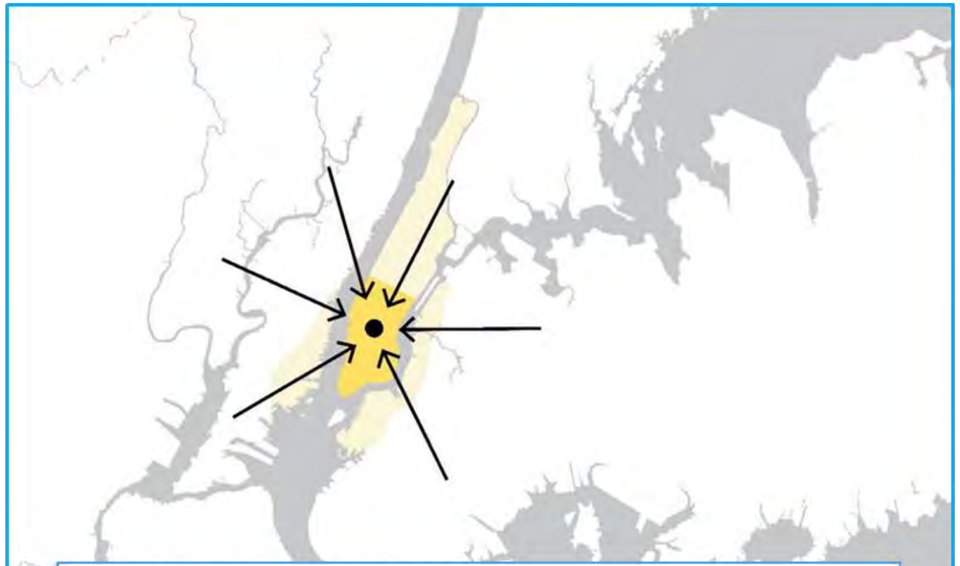
High speed railways	Length of track, km	CapEx, bln USD	1 km cost, mln USD	Annual subsidy on operation of the line, mln USD	Fare cost, USD,
Stuttgart - Muenchen	100	2,3	23,0	92,0	67,0
Madrid - Barcelona	621	10,6	17,1	86,0	138,0
Paris - Lyon	1 003	2,0	2,0	13,0	57,0
Tokyo - Aomori	539	11,0	20,4	41,0	152,0
Beijing - Shanghai	1 433	35,8	25,0	163,0	80,0
Moscow - Kazan	770	25,0	32,5	182,0	55,0

- Costs per 1 km of track in Russia, however, are higher than that of its analogues
- Necessary subsidies on operation amount 180 mln USD

Source: Russian Railways, working group analysis

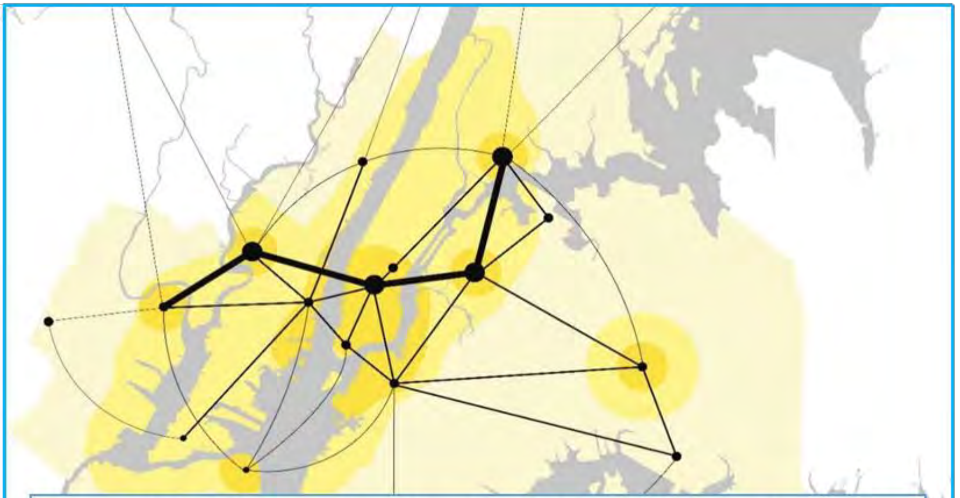
6. Conclusion

6.1 Regional Unified Network (RUN)



2018 NYC: Regional Rail Operations on single nucleus

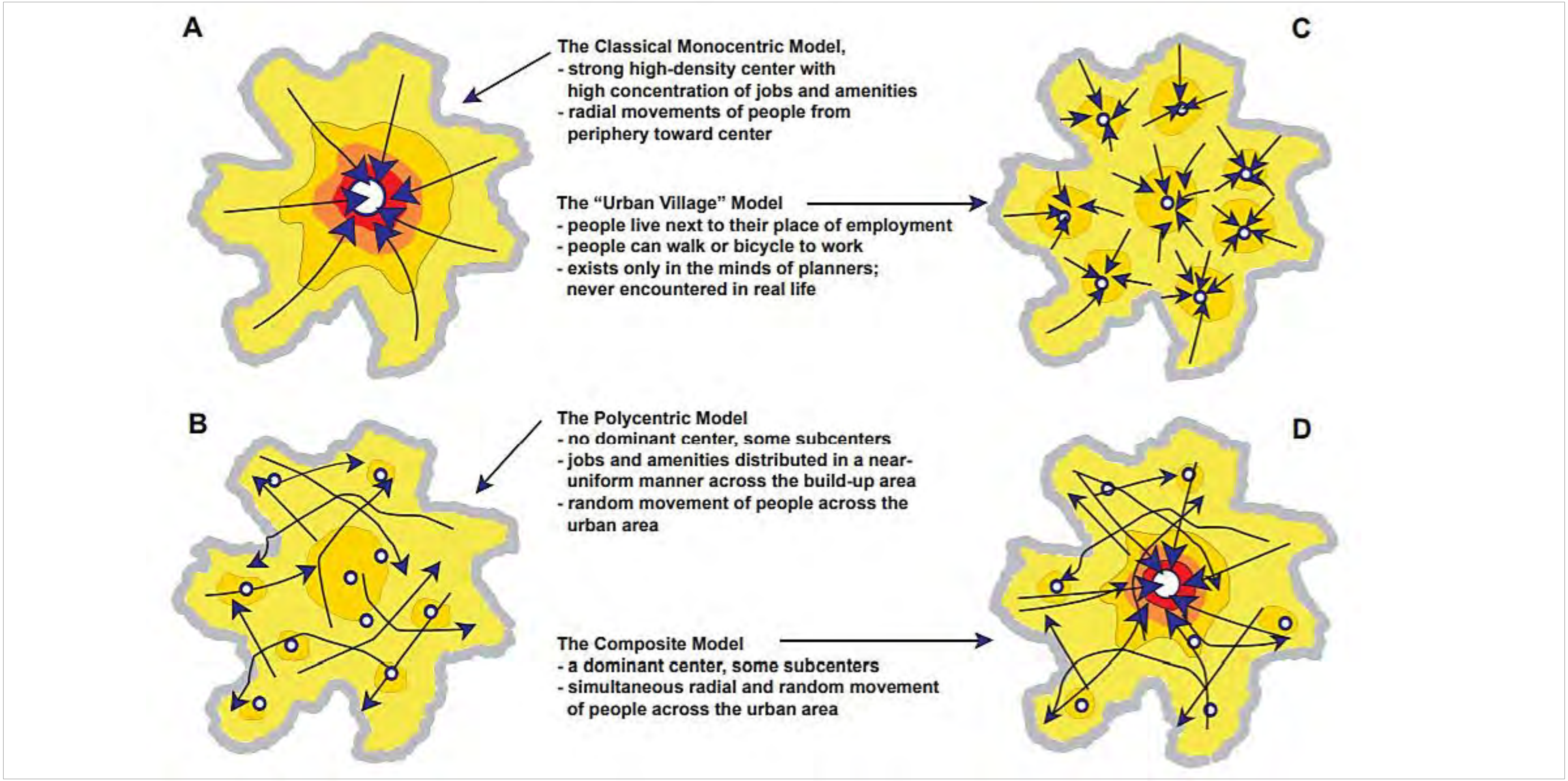
2018 NYC: Dead-end Terminal Penn Station in Manhattan CBD



RethinkNYC Plan 2050: Regional Unified Network (RUN) on satellite cities

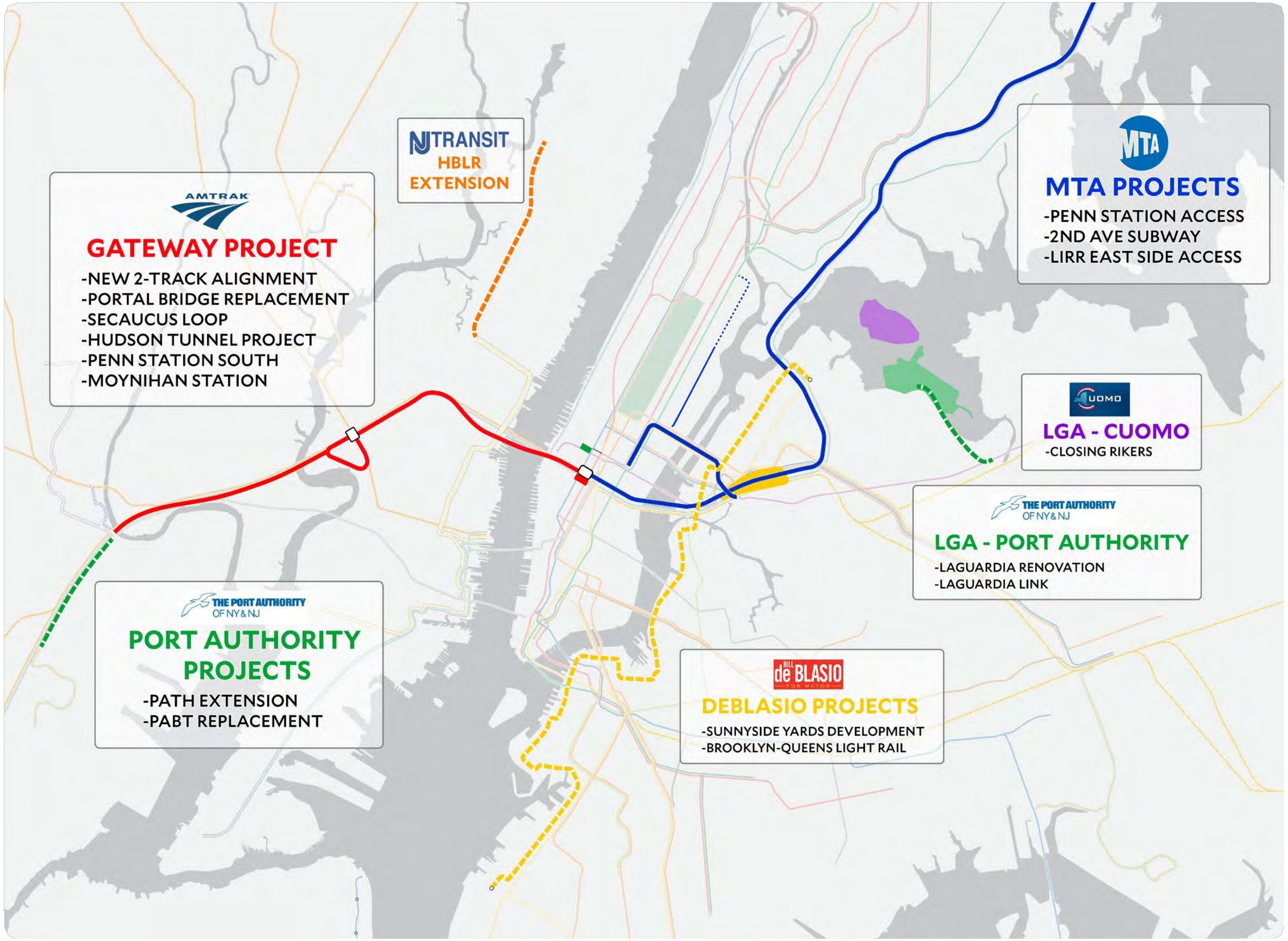
RethinkNYC Plan 2050: Through-running Penn Station in Manhattan CBD and New Transit Hubs

Proven Studies on successful industry linkages create strong economic cluster

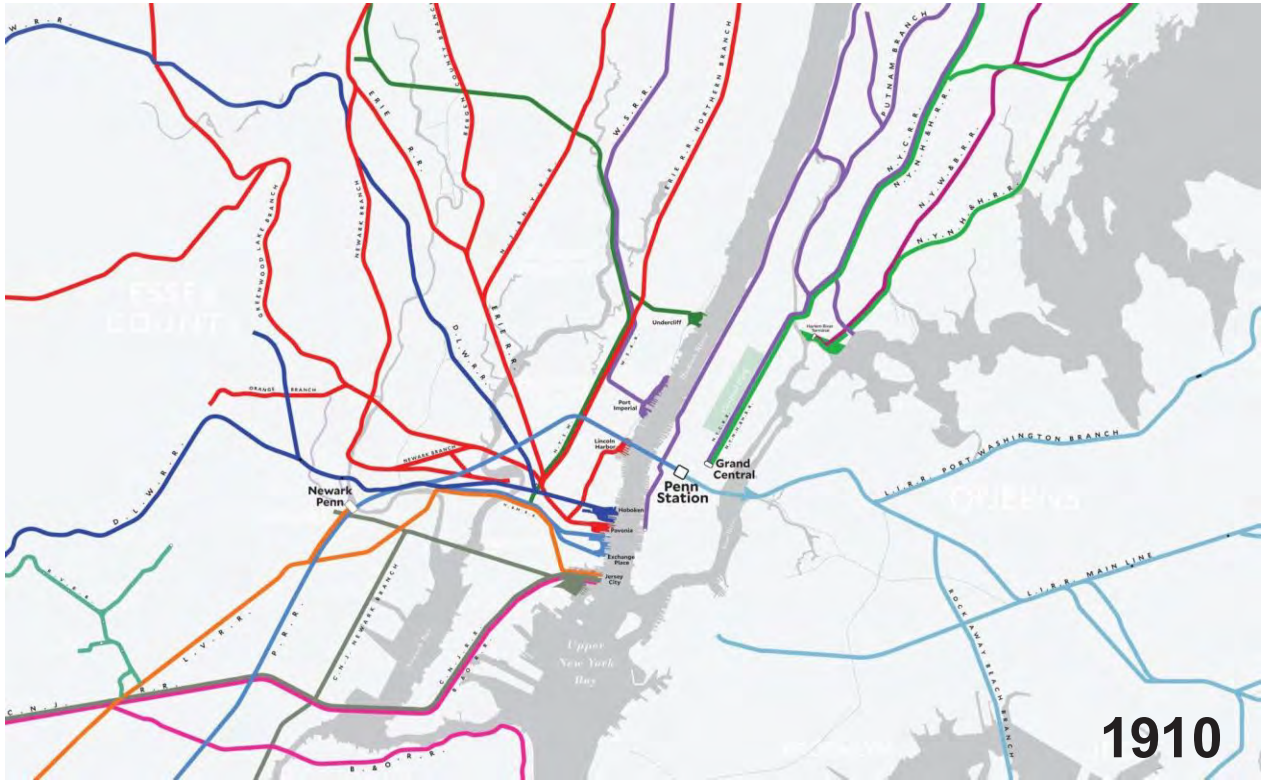


Source: ADB Urban Development Series - Green Cities, Nov 2012 p31

6.2 Reduce administrative layers and competing interests



6.3 History doesn't repeat itself, but it does rhyme - by Mark Twain



New York Region Commuter Rail & Waterfront Terminals, 1910. Penn Station and eight waterfront terminals provided many ways between Manhattan and New Jersey.

New York Region Commuter Rail, 2016. Penn is the primary means of access between New Jersey and Manhattan.

- What's past is past. However, the present can conditionally fall into the same rat hole and the current cast of imprudent can make the same mistakes.
- It's never too late to go to the "*wrong*" direction vs. **What kind of city do people want and how to get there?**

6.4 Amtrak turnaround and learning from the international best practices

8417

REPORT BY THE

Comptroller General

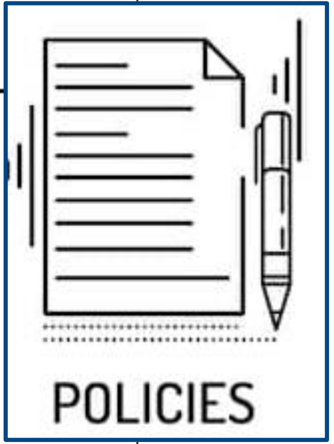
OF THE UNITED STATES

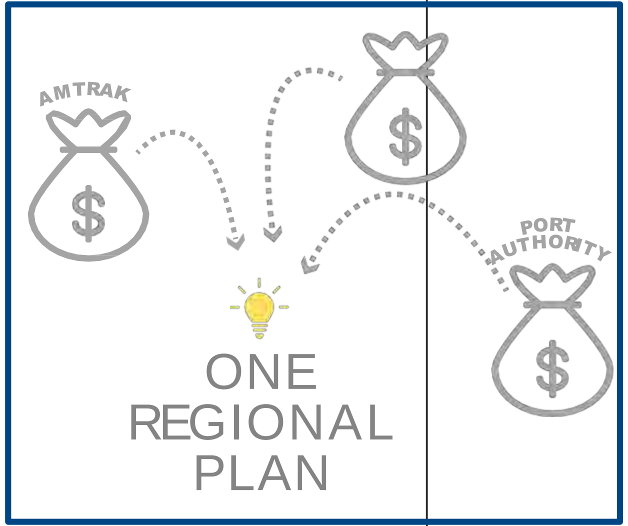
Should AMTRAK's Highly Unprofitable Routes Be Discontinued?

Despite new equipment, improved stations and tracks, changes to schedules, and additional intermediate stops, some routes operated by the National Railroad Passenger Corporation continue to be highly unprofitable and to waste energy. However, they are still operating. Procedures developed for deciding which routes, if any, should be discontinued are not effective.

UNITED STATES GENERAL ACCOUNTING OFFICE

CED-79-3
NOVEMBER 27, 1978





Managing unprofitable passenger rail operations in Japan - Lessons from the experience in Sweden

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Vertical separation
Public finances

JEL classification:
H54
L1
L51
L92
L98

ABSTRACT

Japan implemented a ground-breaking reform in the railway sector in 1987 when it broke up the Japanese National Railways (JNR) into six vertically integrated railway companies. Mainly because of the recent population decrease in local areas, many local rail lines face severe declines in passenger numbers. When it comes to upholding unprofitable public transport, Sweden implemented a radical reform in 1988 by means of vertical separation and decentralisation, and then gradually introduced competitive tendering to procure unprofitable passenger rail services. In this paper, the situation in Japan, and primarily Hokkaido, is presented in some more detail, as well as the situation in Sweden. The study of railway operation and management in the two countries leads to a couple of lessons and implications for sustaining unprofitable but socially beneficial passenger railways. Among the addressed key issues are: 1) establishing the appropriate governance structure that facilitates reaching a better, agreed balance between national government and regional governments; 2) stipulating a standard to select the appropriate transport mode; 3) bearing of the financial responsibility for sustaining specific lines based on an analysis of the benefitting parties.

1. Background to the study and aim of research

In April 1987, the Japanese National Railways (JNR) underwent a major reform. JNR was divided into six vertically integrated companies, and a single vertically separated freight railway company. This case is considered to be a successful reform of a public enterprise in Japan as transport volumes and productivity of railways, as a whole, have increased substantially. However, mainly because of the recent population decrease in some parts of Japan, many local rail lines now face severe declines in passenger numbers. For JR Hokkaido (HJR), where the average passenger traffic density is lower than most other JR companies, managing the railways has been particularly difficult. In November 2016, the company announced that 1,237 km of lines cannot be sustained only through the revenues from the businesses and the interest payments of the Management Stabilization Funds (MSF). Consequently, it has become necessary to take certain measures if these unprofitable lines should be kept in the future. As this status shows, despite the overall success of the 1987 JNR reform, the current railway management in Japan requires some measures in order to uphold operation of local lines.

In Sweden, a major reform of the Swedish State Railways was initiated in 1988, in which rail infrastructure was vertically separated from train operations, and responsibility for many unprofitable passenger lines was decentralised to regional governments. This was later followed by the introduction of procurement of rail services by competitive tendering. Today, both the national government and regional governments allocate funds to the railway sector to sustain unprofitable passenger railway services when they are socially beneficial.

Based on a study of the experiences and schemes to allocate public spending to unprofitable passenger railway services in Sweden, this paper seeks to address the key issues necessary to sustain such railway services in Japan. The underlying idea is that, although there may be many differences between Japan and Sweden, there could still be sufficient similarities in the conditions for rail passenger services if we focus our analysis on the island of Hokkaido, making it relevant to consider some of the lessons from Sweden.

Table 1 provides a very basic comparison, in terms of geography and population, between the three Japanese islands Hokkaido, Shikoku and Kyushu, as well as a comparison with Sweden, divided as traditional into its three parts Götaland, Svealand and Norrland (for a map,

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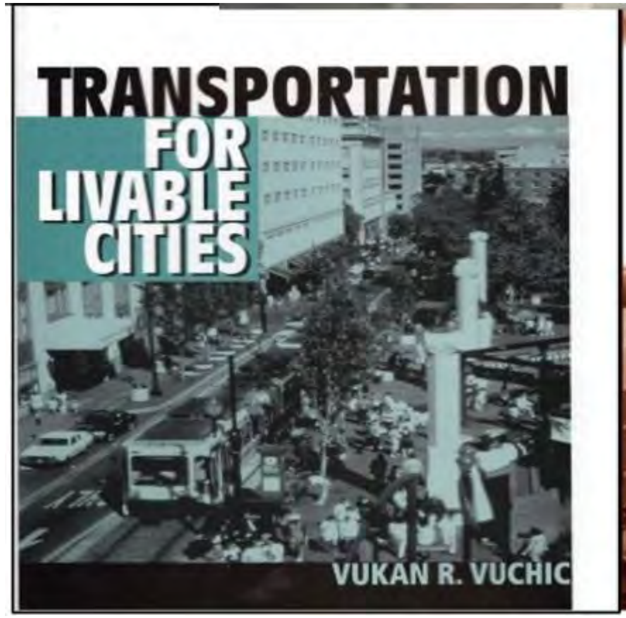
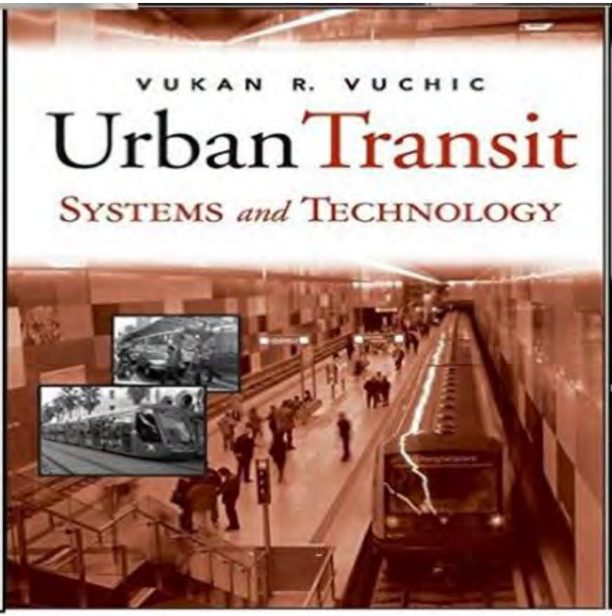
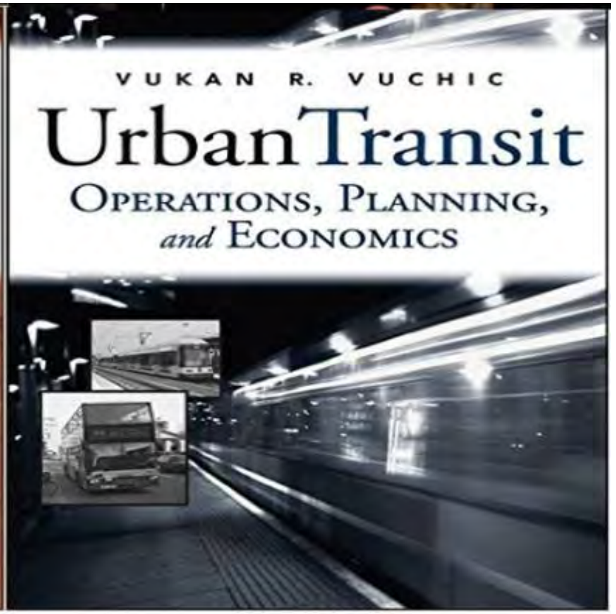
Dr. Vukan R. Vuchic's Urban Transit Trilogy







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Urban Transit for Livable Cities

Module	1. Cities and Transportation: Evolution of Transport Modes	2. Highway Transit: Buses, Trolleybuses, BRT and Paratransit	3. Rail Transit: Tramways/ Streetcars, LRT, Metro, Regional Rail	4. Rail Transit Characteristics, Operations and Roles	5. Rail Transit Networks, Scheduling and Performance	6. Fare, Financing, Ownership and Regulation	7. Transit Planning, Mode Selection and Design	8. Transportation for Livable Cities: Policies and Implementation Measures
1.	Impacts of Transportation on Cities	Definitions and Characteristics	Characteristics of Rail Transit Modes	Rail Transit Stops and Stations	Network Planning Objectives	Objectives in Fares Determination	Short-and Long-Range Transit Planning	City Sizes and Roles of Different Transport Modes
2.	Evolution of Transport Modes with City's Growth	The Vehicles	Tramways/Streetcars and Light Rail Transit - LRT	Transfer and Integrated Stations	Network Types: Independent vs. Integrated Lines	Structure of Fares and Their Characterisrics	Planning Procedure	Short-Term Solutions vs. Long-Term Optimum System
3.	Definitions of Transit Modes	Trolleybus System and Vehicles	Metro/Rail Rapid Transit	Intermodal Rail Stations and Feeder Modes	Geometric Forms of Transit Lines	Fare Collection and Payment Control	Travel Demand Forecasting	Defining of Balanced Intermodal Urban Transportation
4.	Three Categories of Transit Modes	Bus Ways, Lanes and Stops	Regional (Commuter) Transit - RGR	Train Travel Control: ATP, ATO, and ATS	Transit Line Scheduling: Input Information and Operating Standards	Types and Levels of Fares	Modal Split and Trip Assignment	Structure of Travel Costs by Different Modes
5.	Technologies of Transit Modes	Bus Lines, Networks and Transfer Stations	Review of the Family of Rail Transit Modes	Crewless Train Operation - CTO or UTO	Transit Scheduling Computations	Principles and Trends in Financing Transit Systems	Design of Alternative Plans	Policies and Measures for Achieving Balanced Transportation
6.	Classification and Characteristics of Transit Modes	Intermodal Bus-Rail Transfer Stations	Rolling Stock	Automated Medium-Capacity Transit Modes	Schedule Presentations	Government Agencies and Professional Organization for Transit	Comparative Analysis, Evaluation and Selection of Plans	Transit Use Incentives
7.	Elements of Transit Systems Operations	Bus Rapid Transit – BRT	Geometric Elements of Line Alignments and Cross Sections	Monorail and Low-Speed Maglev	Crew Scheduling or Run Cutting	Transit System Development and Regulation	Preliminary Transit System Design	Auto Use Disincentives
8.	Performance Attributes of Transit Operation and Service	BRT in Developing and in Industrialized Countries	Rail Transit Rights-of-Way: Surface, Aerial and Tunnel	Specialized Technology Systems	Timed Transfer Systems - TTS	Purposes and Types of Transit Regulation	Integrated Regional Rail Network of SEPTA in Philadelphia, PA, USA	Cities with Rapid Increase of Auto Ownership
9.	Transit Line Capacity	Paratransit: Definition and Classification	Construction Methods of Shallow and Deep Tunnels	Rail Transit Performance and Costs	Accelerated Services	Regulated and Deregulated "Free Market Transit"	Planning Further Modernization of SEPTA's Regional Rail	Present Problems and Prospects in Different Cities
10.	Vehicle Motion, Regimes of Travel and Station-to-Station Travel Time	Paratransit Characteristics and Roles	Rubber-Tired Metros	Present and Future Role of Rail Transit Modes	Modeling and Systems Analyses in Transit	Functionally Integrated Intermodal Transit System	Upgrading "Subway-Surface Trolleys" in Philadelphia into Light Rail Transit	Leading Livable Cities with Balanced Transportation System

Section / Module

Penn Engineering edX

Online course structure

Course Instructor: Emer. Prof. Vukan R. Vuchic
Project/Technical Manager: Eugene Chao, PMP

February 1th 2017

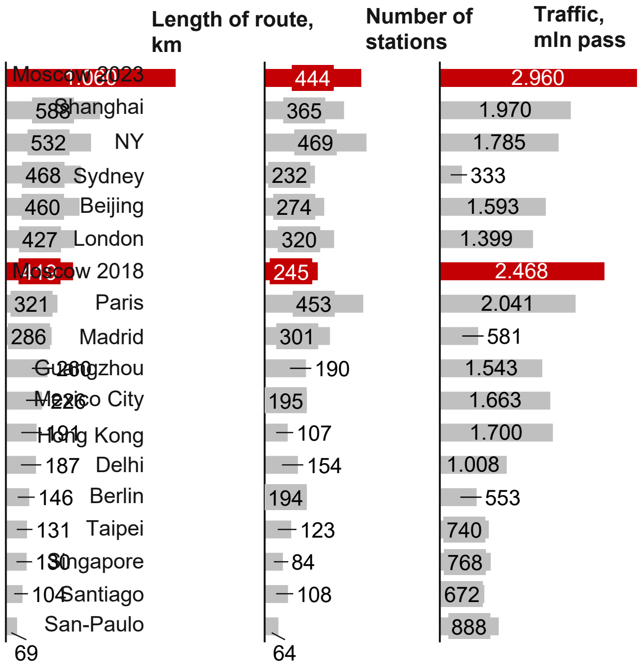
Thank you

Appendix

Moscow Central Diameters

Wharton
UNIVERSITY of PENNSYLVANIA
ALTERNATIVE INVESTMENTS Initiative

Alternative to HSR-2 «Moscow – Kazan» the same budget may be allocated to the new ground metro lines in Moscow - Moscow Central Diameters with better effect



5 min. intervals between trains during rush hours

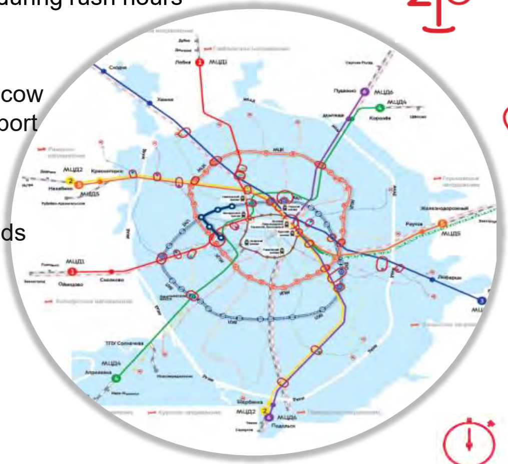
Length of station stop – **1 minute**

Integration within the Moscow and Moscow region transport system

Public transport integration

Unified payment methods

Clear navigation



Improved transport service for **2,6 mln** people

High-tech and comfortable trains

2,280,000 Passengers seats per a day

Decreasing travel time more than **2 times**

Effects after the introduction of MCD-1 and MCD-2 in 2019 - 2020

Reduction of passenger traffic intensity:

10% metro lines adjacent to MCD

20% central railway terminals

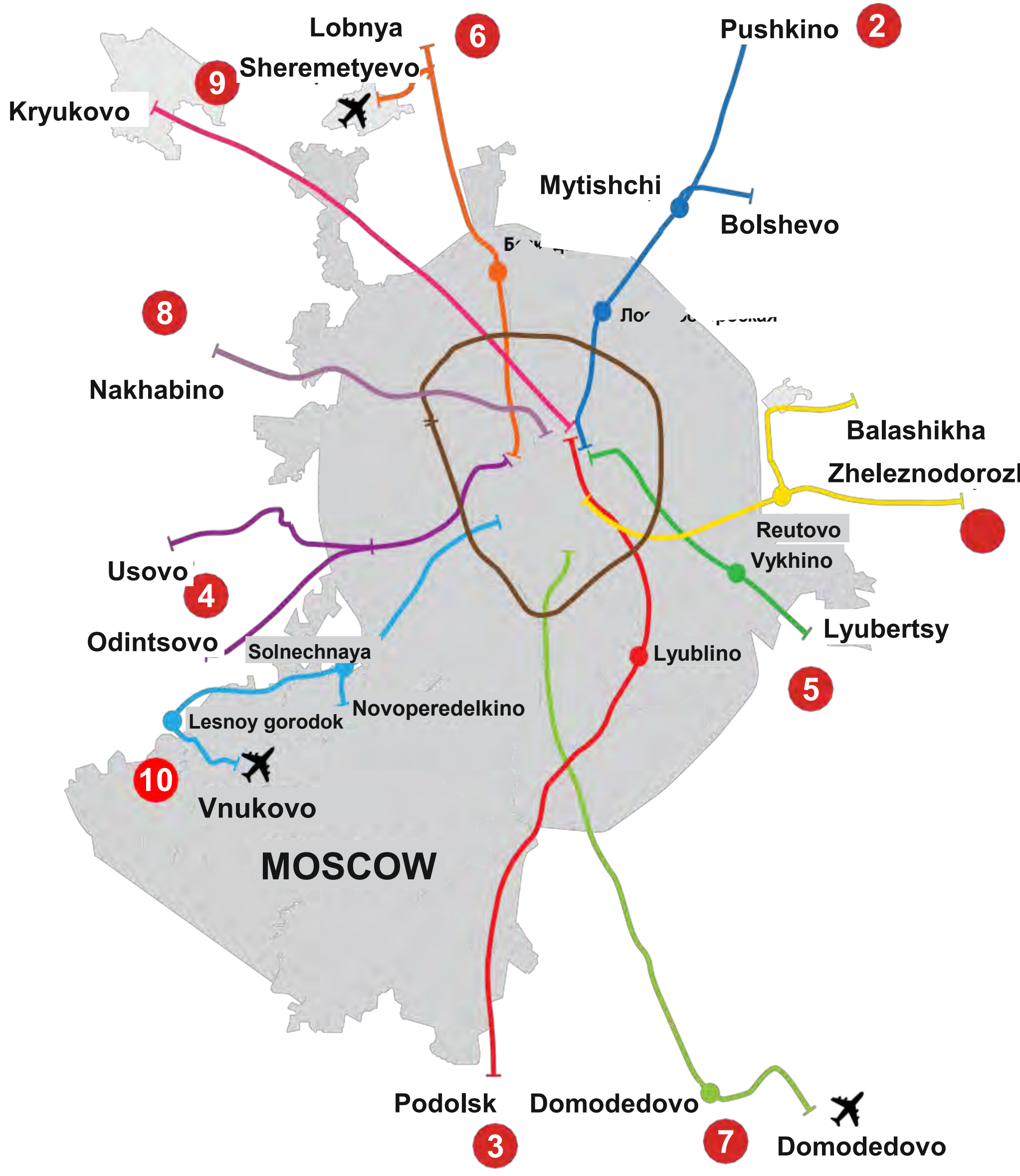
12% all Moscow transport infrastructure

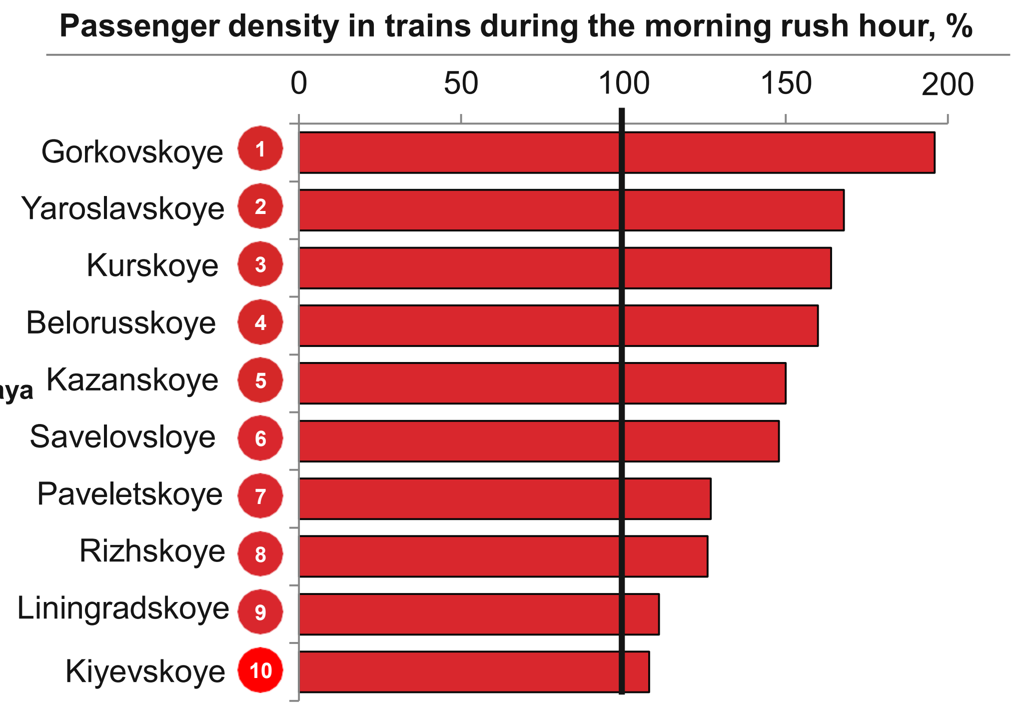
Main indicators for MCD-1 и MCD-2 (2019 – 2020)

	Length of route, km	Number of stations	Traffic, mln pass per year
MCD1 (Odintsovo-Lobnya)	52	28	42,9
MCD2 (Nakhabino-Podolsk)	80	38	48,6
Total	**132**	**66**	**91,5**

Moscow Central Diameters will reduce the infrastructure restrictions in Central Transport Railway Hub for the quality increase of transport service in Moscow

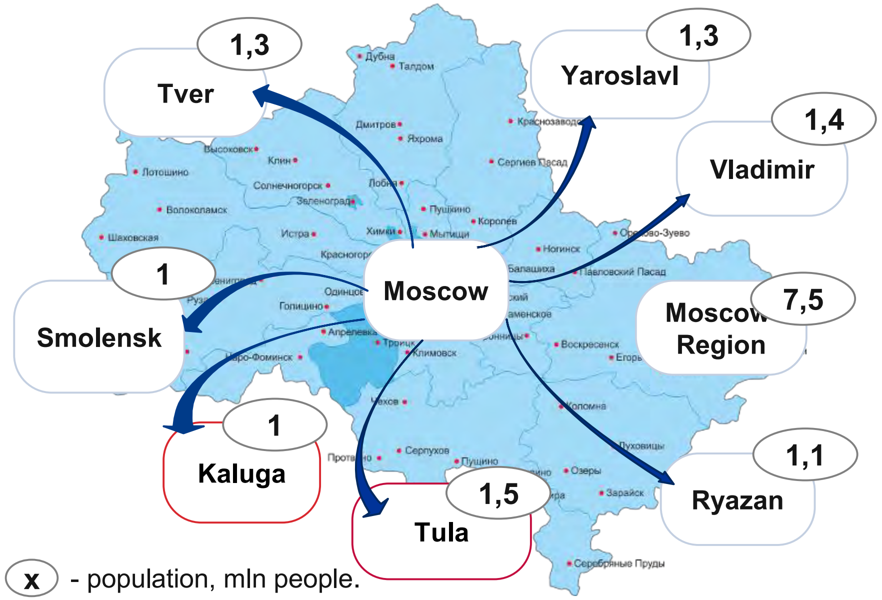
Existing lines





- All the lines are overloaded in peak hours
- The high density of population of trains sharply reduces appeal of local trains to passengers
- MCD launch will reduce the intervals, provide with additional track construction, and will help get rid of infrastructure restrictions

Moscow Central Diameters will improve the communication between the economic centers and regions of the Russian Federation



x - population, mln people.

Infrastructure of Central Transport Hub is used in 14 regions by more than 1,8 mln people a day

Moscow region	1,243	69%
Moscow	488	27%
Vladimir region	44	6% (14 regions)
Kaluga region	28	
Tula region	13	
Other regions	5	
Total	**1,821**	

Travel time reduction:

Route	To Moscow by car	To the nearest Metro station after the MCD launch	Reduction
Moscow - Kaluga	4 h 8 min	2 h 20 min	2 times
Moscow – Tula	4 h	2 h	2 times
Moscow – Ryazan	4 h 22 min	2 h 40 min	1,5 times
Moscow – Vladimir	4 h 24 min	2 h	2 times
Moscow – Yaroslavl	4 h 5 min	2 h	2 times
Moscow – Tver	3 h 22 min	55 min	3,5 times
Moscow – Smolensk	6 h 20 min	4 h 20 min	1,5 times

Passenger seats

Route	Currently	Projected	Increase
Moscow - Kaluga	19 264	38 528	100%
Moscow – Tula	13 244	34 916	164%
Moscow – Ryazan	20 468	40 936	100%
Moscow – Vladimir	8 428	18 060	114%
Moscow – Yaroslavl	-	24 080	100%
Moscow – Tver	27 692	37 324	35%
Moscow – Smolensk	-	24 080	100%

- **More than 33 mln people live in Moscow region and nearest regions**
- **About ¼ of Russians will feel the transport service quality increase inside the regions**

Main features

peak-hours

5 minutes headway in peak-hours

No service break during the day

Interchanges to urban transport

Comprehensible

Modern and convenient rolling stock

Integration in the transport system of Moscow and Moscow Region

Payments with «Troika» card

Working hours are the same as in Moscow Metro: 5:30 a.m. – 1:00 a.m.

Benefits of starting MCD-1 and MCD-2

Improved transport services for 2,3 mln. people

Travel time reduced more than twice

889 thousand passenger places a day

Reduction of pressure on the transport systems

- 10 % for adjacent metro lines
- 3-5 % for street and road network (The Moscow Automobile Ring Road, The Third Ring Road, Garden Ring)
- 20-25 % for central railroad terminals
- 12 % for all transport infrastructure of the city

Moscow Central Circle and New Rolling Stock

Moscow Central Circle is a pioneer of implementing the innovative solutions in public transport

High-tech "Lastochka" trains

and continuous welded rail

15% reduction of passenger traffic intensity of the Circle Line

20-40% reduction of passenger traffic intensity of central railway terminals

5 min. intervals between trains during rush hours

54 km length of MCC

31 interchange station to ground transportation

20 interchange stations to Moscow Metro

10 interchange stations to railway transport

Unified ticket system with Moscow Metro

and unified city navigation

Accessibility of public places

Innovative passenger services

and equipment for the disabled

** Source: Moscow Metro, Russian Railways*

MCC rolling-stock

High-tech "Lastochka" trains running at MCC

42 «Lastochka» trains

177 train pairs per working day
150 trains per weekend day

1 500 people
train maximum capacity

40 years life cycle of a train

Climate-control system

Cycling carriers
Wheelchairs and carriages can be transported in 2^{nd} or 4^{th} car

Equipment for people with disabilities

Wi-Fi

Pass-through

Vandal-resistant glass

Washrooms
in 1^{st} and 5^{th} car

220 V charger

Special allocation of seats
2+2 arrangement

Hand-rails for passengers

Monitors in cars

** Source: Moscow Metro, Russian Railways*

Life cycle contracts accelerate the process of surface public transport vehicles renewal and improve economic efficiency of SUE «Moscow Metropolitan»

ROLLING STOCK

Cars' delivery	Time of delivery	Contract term	Price of contract	Annual payment
336	**since 2016**	**15** years	**391** mln. USD	**26** mln. USD

LCC gives opportunity to divide expenses for rolling stock for extended time length and reduce operational costs

** Source: Moscow Metro*

«Moskva» train is created by passengers and specialists of Moscow Metro

More than 150 proposals from passengers concerning «Moscow» train functional specifications were received and analyzed at «Aktivniy grazhdanin» (Active citizen) platform.

- USB charging devices installed at intermediate cars
- Handrails of special form
- Special adaptive lighting and air conditioning

Proposals from drivers led to improvement of technical aspects of the rolling stock

- Improvements in driver's control and informing system
- Sensors monitor more than 100 indicators

«Moskva» train (81-765)

264 cars / 33 trains already delivered
1640 cars / 212 trains will be delivered till 2020

Lighting

USB-chargers

Walkthrough gangways

Informational panels

- Air conditioning and disinfection systems
- Sensor informational panels with interactive metro map and opportunity to create routes
- Adaptive lighting – cold in the morning and warm in the evening

** Source: Moscow Metro*

Life cycle contracts accelerate the process of surface public transport vehicles renewal and improve economic efficiency of SUE «Moscow Metropolitan»

ROLLING STOCK

Cars' delivery	Time of delivery	Contract term	Price of contract	Annual payment	Reduction of maintenance costs
1 576	since 2014	30 years	5 390 mln. USD	180 mln. USD	15 %

LCC gives opportunity to divide expenses for rolling stock for extended time length and reduce operational costs

** Source: Moscow Metro*