Forum Guru Besar - Institut Teknologi Bandung
WEBINAR November 27, 2020

The High-Speed Train Jakarta-Bandung and Its Development Prospects in Java Island

Regional and Social Aspects in Developing HSR in Java Island

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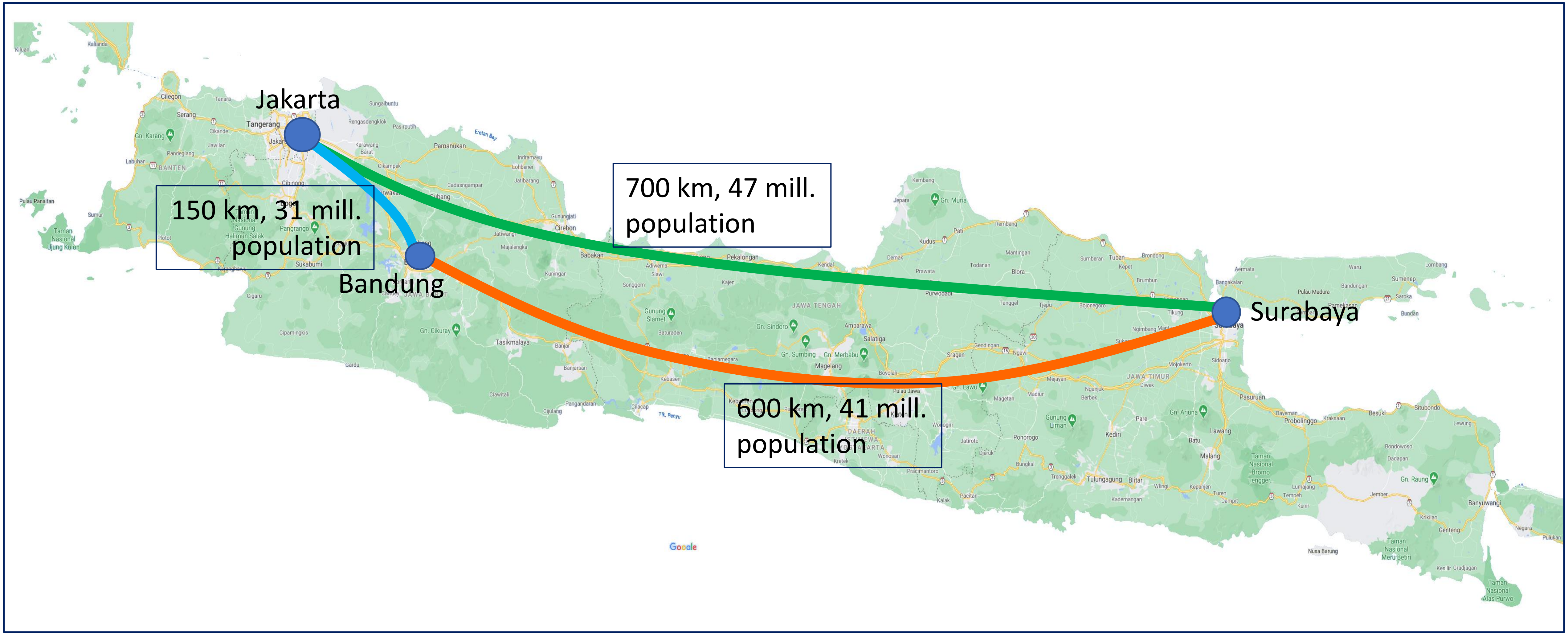


Issues of HSR Development in Indonesia

- What are the available existing services?
- Are the existing services meeting the need (quantity and quality)?
- Is the available system operated efficiently?
- Is the available system capable to anticipate the future need?
- If a new service is proposed, how this will improve the entire system?
- What is the market (volume, regularity, growth) of the new service?
- What are the costs, benefits, impacts?
- Who will finance the project? Who will operate?
- What is the readiness for project planning and implementation?
- Etc…etc…..

The Need for Multi Criteria Assessment (1/2)

1. Regional (economic) development impacts (Economic feasibility)
2. Social and Environmental Impacts
3. Transport Impacts: increase transport network capacity, reduce road traffic (energy savings, lower accidents), reduce greenhouse gas emissions
4. Construction/Investment costs:
    - Line length
    - Line capacity (rolling stocks, facilities, utilities)
    - Route location: topographical and geological condition
    - Land acquisition

The Need for Multi Criteria Assessment (2/2)

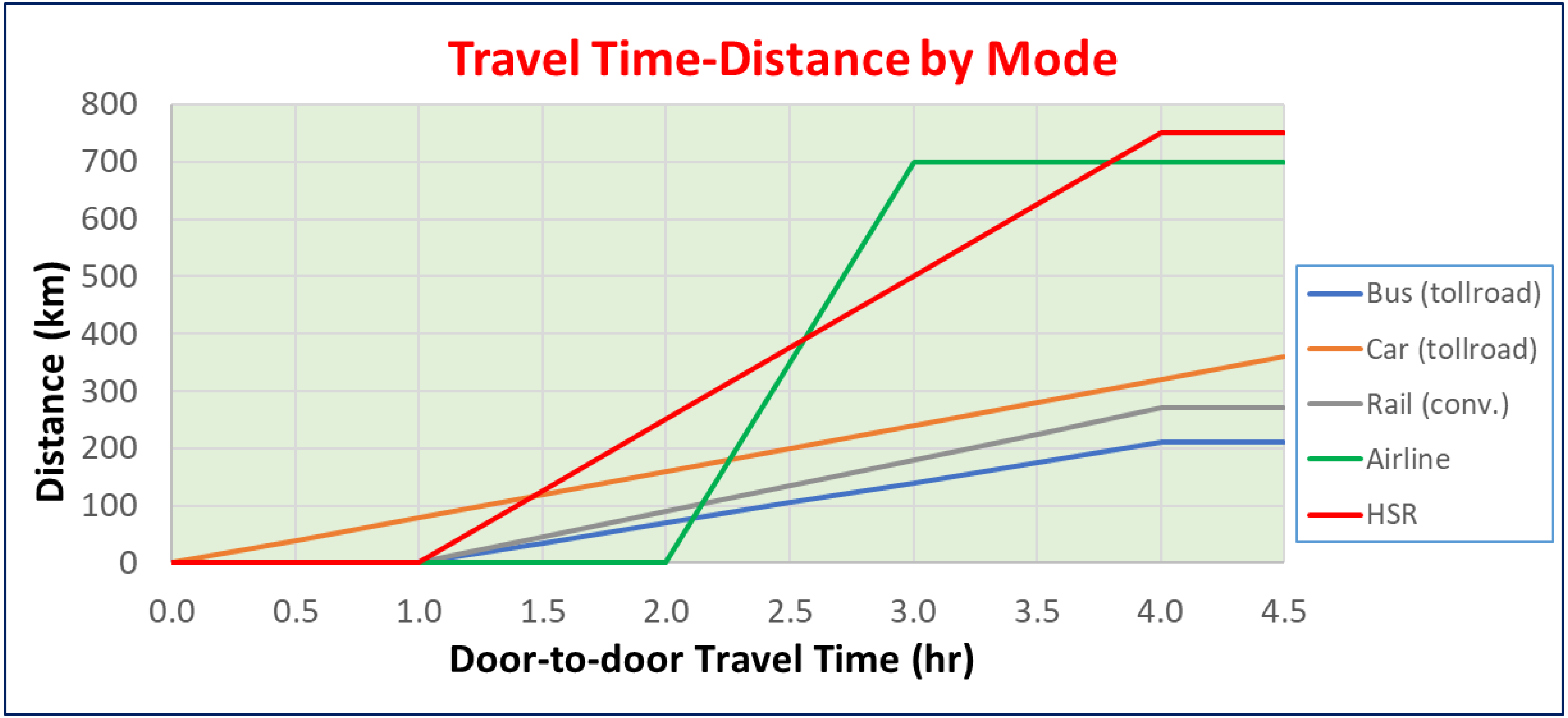
5. Technological Development:
   - ✓ Local know-how and technology
   - ✓ Technology transfers
6. Financing and Funding (Financial viability)
7. Investment Strategy, Partnership
8. Risks (development, demand, construction, OM, financial, economic, force majeure, political, etc.)
9. Other criteria: national pride and wider strategic impacts

Multimodal Comparison

- Competition with other modes: door-to-door time, service quality, price
- Market share:
  - ✓ very competitive to airline for medium distance (200 to 800 kms)
  - ✓ competitive to cars for shorter distance in congested road networks
- High line capacity (Typical (800 - 1,000) pass/train x 12 trains/hr = 9,600 - 12,000 pass/hr/direction; Tokaido Shinkansen Japan: 20,000 pphpd)
- Convenience: multiple stops, service frequency, service hours
- Energy efficiency (lower energy consumption per pass-km; source of energy: fossil fuel, nuclear, renewables)
- Other competitive aspects: weather dependency, safety, comfort, delays (in line and terminal)
- Other issues: air pollution and noise (depending energy sources and technology)
- Major challenges: land requirement, investment cost, crossing difficult topographical/ geotechnical areas)

Travel Time – Distance Comparison

MODE	Access Time	Terminal Time	Avg. Vehicle Speed	Luggage Pickup	Egress Time
	(hour)	(hour)	(km/hr)	(hour)	(hour)
Bus (toll road)	0.5	0.5	70	0.0	0.5
Car (toll road)	0.0	0.0	80	0.0	0.0
Rail (conv.)	0.5	0.5	90	0.0	0.5
Airline	1.0	1.0	700	0.5	1.0
HSR	0.5	0.5	250	0.0	0.5



Market for HSR: Demand Estimation

- **Potential market**: high and medium income population (higher value of time)
- **Diversion from existing modes** (airline, existing train, private car, bus)
- **Diversion from other destinations**
- Increase by **income and population growth**
- **New (induced) demand**: new development in the corridor (manufacturing industries, service industries, trade, tourism, etc.)

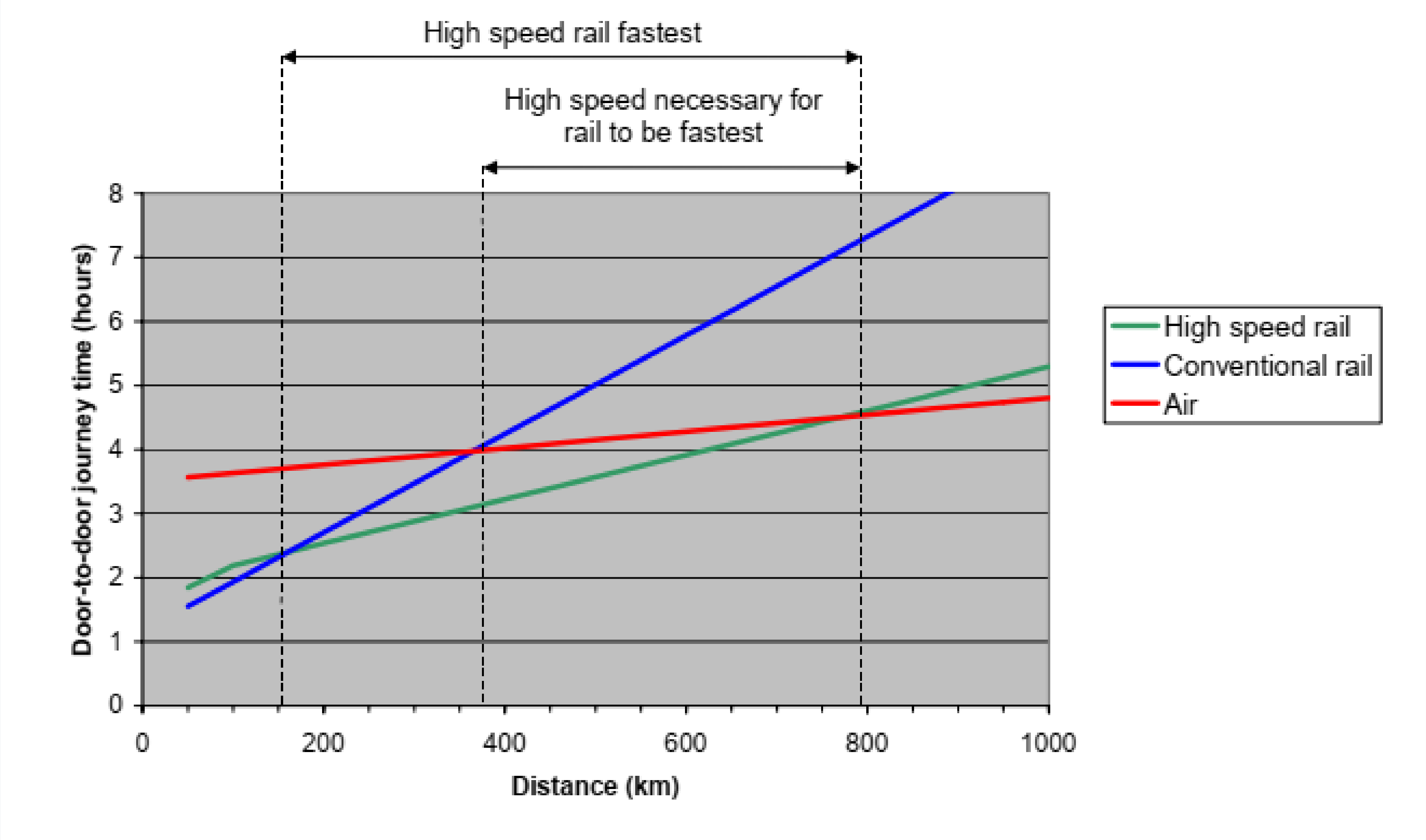
Market for HSR

(Source: Steer Davies Gleave, High Speed Rail: International Comparisons, February 2004)

- The case for **HSR is strongest in countries where there is a large market** for travel over distances of around **200-800km**, and **particularly in the range 300-600km**. HSR offers little benefit for journeys shorter than 150-200km and is currently not be competitive with air transport for journeys longer than approximately 800km.
- **A HSR line can offer very high capacity**. For there to be **sufficient travel demand** for this capacity to be utilised effectively, there must either be **very large cities** of approximately the **right distances apart**, or there must be a number of **significant population centres** that can be accessed by the same HSR route.
- The construction of HSR lines is likely to be least difficult in sparsely populated countries, but within cities, **high population densities mean that HSR (and conventional railways) can serve the potential market better**.
- The existence of very good conventional rail lines reduces the incremental economic case for HSR, although **if it is possible to use existing railway lines on final approaches to major cities, the construction costs of HSR can be significantly reduced**.

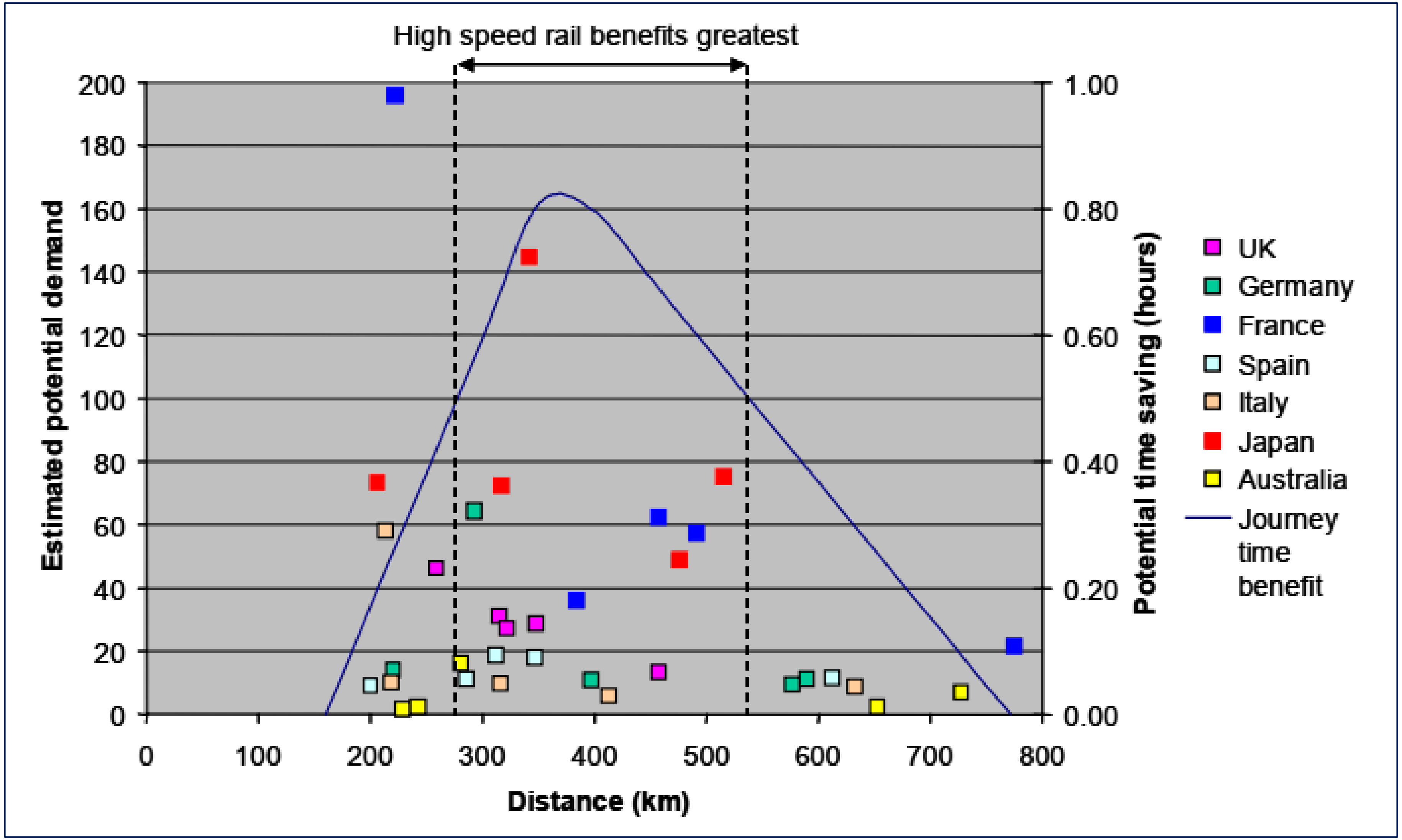
Competitive Advantage of HSR

(Source: Steer Davies Gleave, February 2004)



Potential Demand for and Benefits of HSR

(Source: Steer Davies Gleave, February 2004)



HSR Market Shares – Europe and Japan Experience

- European data indicate that **air traffic is more sensitive than road traffic (car and bus) to competition from HSR, at least on journeys of 400 km (249 mi) and more**.
- **TGV Sud-Est reduced the travel time Paris–Lyon from almost four to about two hours**. Market share rose from **40 to 72%.** Air and road market shares shrunk from 31 to 7% and from 29 to 21%, respectively.
- On the **Madrid–Sevilla link**, the AVE connection increased **share from 16 to 52%;** air traffic shrunk from 40 to 13%; road traffic from 44 to 36%, hence the rail market amounted to 80% of combined rail and air traffic. This figure increased to 89% in 2009 (Spanish rail operator RENFE).
- A study conducted on **Japan's HSR services found a "4-hour wall"** in HSR's market share, which **if the HSR journey time exceeded 4 hours, people would likely choose planes over HSR**.
  - From **Tokyo to Osaka**, a 2h22m-journey by Shinkansen, high-speed rail has an **85% market share** whereas planes have 15%.
  - From **Tokyo to Hiroshima**, a 3h44m-journey by Shinkansen, high-speed rail has a **67% market share** whereas planes have 33%.
  - The situation is the reverse on the **Tokyo to Fukuoka** route where high-speed rail takes **4h47m** and rail only has **10% market share** and planes 90%.

HSR Market Shares – China Experience

WB Report (China's High-Speed Rail Development, 2019):

- HSR is suited to **medium-distance travel markets with very high travel demand**.
- **HSR is very competitive** with other modes for distances of **150–800 km** (about three to four hours travel time), and **the 350 kph service is competitive up to 1,200 km**.
- **For shorter distances, customers prefer bus and private automobile**, and **for longer distances customers prefer air**.
- **Fares are competitive with bus and airfares** and are about **one-fourth the base fares in other countries**. This has allowed high-speed rail to attract more than 1.7 billion passengers a year from all income groups.
- Achieving **reasonable occupancy at a minimum service level** (hourly between 7:00 AM and midnight) **requires 4 million passengers per year** and **achieving financial viability at Chinese costs and fares requires 40 million passengers per year**.

HSR and Airline World Ridership

(Wikipedia, October 2020)

Comparison of HSR and airlines annual passengers worldwide (in millions), (HSR with 200 km/h (124 mph) service speeds or higher)		
Year	**Annual world HSR**	**Annual world airlines**
2000	435	1,674
2005	559	1,970
2010	895	2,628
2012	1,185	2,894
2014	1,470	3,218
2016	2,070	3,650

10 Highest HSR Network

(Source: Richard Nunno, Environmental and Energy Study Institute, October 2020)

No	Country	GDP (PPP) 2019 (mill. current $) (*WB)	Length of lines in operation (km)	Lines under construction (km)	Approved but not started construction	Max speed (km/h)
1	China	23,460,170	26,869	10,738	1,268	350
2	Spain	1,987,305	3,100	1,800	0	310
3	Japan	5,459,155	3,041	402	194	320
4	France	3,315,118	3,220	125	0	320
5	Germany	4,659,795	3,038	330	0	300
6	Sweden	574,078	1,706	11	0	205
7	UK	3,255,484	1,377	230	320	300
8	South Korea	2,224,985	1,104	376	49	305
9	Italy	2,664,946	999	116	0	300
10	Turkey	2,325,617	802	1,208	1,127	300
22	USA	21,427,700	54	192	1,710	240

Indonesia:
HSR 142,3 km under construction,
GDP (PPP) 2019: 3,329,169 mill. $

Many of these trains and their networks are technically capable of higher speeds but they are capped out of economic and commercial considerations (cost of electricity, increased maintenance, resulting ticket price, etc.).

Several Operational HSR Lines and Ticket Prices

Country	HSR OPERATOR	ROUTE	DISTANCE	DURATION	AVERAGE PRICE	USD/ 100km
France-Belgium	THALYS	Trains Paris – Brussels	264 km	01 h 22	103 €	**46.9**
France	SNCF	Trains Lyon – Paris	391 km	1 h 57	92 €	**28.2**
Spain	renfe AVE	Trains Madrid – Barcelona	506 km	2h 50	80 €	**19.0**
Italy	TRENITALIA GRUPPO FERROVIE DELLO STATO ITALIANE	Trains Rome - Milan	477 km	03 h 40	84 €	**21.1**
Germany	DB	Trains Frankfurt – Berlin	424 km	4 h 10	88 €	**24.9**
Europe	EUROSTAR	Trains London - Paris	343 km	2 h 30	164 €	**57.4**
Europe	EUROSTAR	Trains London - Amsterdam	357 km	4 h 10	147 €	**49.4**
Japan	JR Central JR	Tokyo – Osaka	515 km	2 h 30	14,500 ¥	**27.2**
China	CRH	Beijing–Shanghai	1,318 km	4 h 50	949 CNY	**10.9**

Argument for Fast HSR Development in China

(Source: Richard Nunno, Environmental and Energy Study Institute, October 2020)

1. Provides a fast, reliable and comfortable means of **transporting large numbers of travelers in a densely populated country over long distances** and **improves economic productivity and competitiveness** in the long run.
2. **Stimulated the economy in the short term** by creating construction jobs and helping drive demand for construction.
3. **Facilitates cross-city economic integration** and **promotes the growth of smaller cities** by connecting them with larger cities.
4. **Supports energy independence and environmental sustainability**, as electric trains use **less energy** to transport people and goods per unit and can draw **power from more diverse sources of energy (including renewables)** than automobiles and aircraft.
5. **Fosters an indigenous HSR technology and components industry**; Chinese train equipment manufacturers have quickly absorbed foreign technologies (such as Japan's Shinkansen systems), localized production processes, and begun competing with foreign suppliers in the export market.

Reasons for Slow HSR Development in USA

(Source: Richard Nunno, Environmental and Energy Study Institute, October 2020)

1. The **lower population density of U.S. cities** compared to those in Europe and Asia makes it difficult to give high-speed rail large enough numbers of people to make it economically viable.
2. **Stronger property rights** in the United States compared to other countries, which make it **difficult for governments to purchase land for new railroads**.
3. **America's car culture** and emphasis on driving (**and big automotive market**).
4. **The difficulty of shifting to public transit** once city infrastructure has already been built and been **designed for automobile accessibility rather than train stations**.
5. **U.S. long distance railways are mostly owned by freight companies**, forcing passenger rail carriers to yield **priority to freight trains**.
6. The **greater distance between many U.S. cities** allows many transportation needs to be **more conveniently served by commercial airlines**.

Cost Comparison of International HSR

(Source: PWC, November 2016)

Total Comparator Projects	Cost Comparators	Key Similar Characteristic Comparators
32	20	12

8,261 HS Route Length of Comparators (km)

1,629 Number of comparator bridges and viaducts

135 Number of comparator tunnels

69 Number of comparator stations

The study reviewed over £230bn of HSR projects across 8,261km of railway in 12 countries (32 international HSR comparator schemes).

Key Comparators Summary

World map with key comparators highlighted

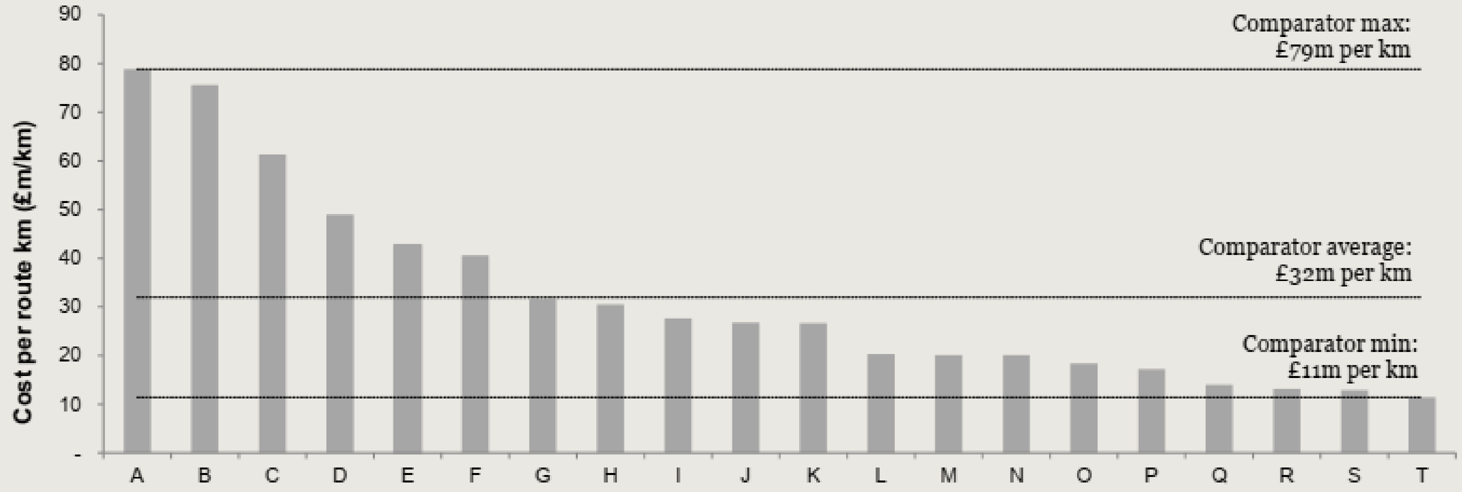
Cost Comparison of International HSR

(Source: PWC, November 2016)

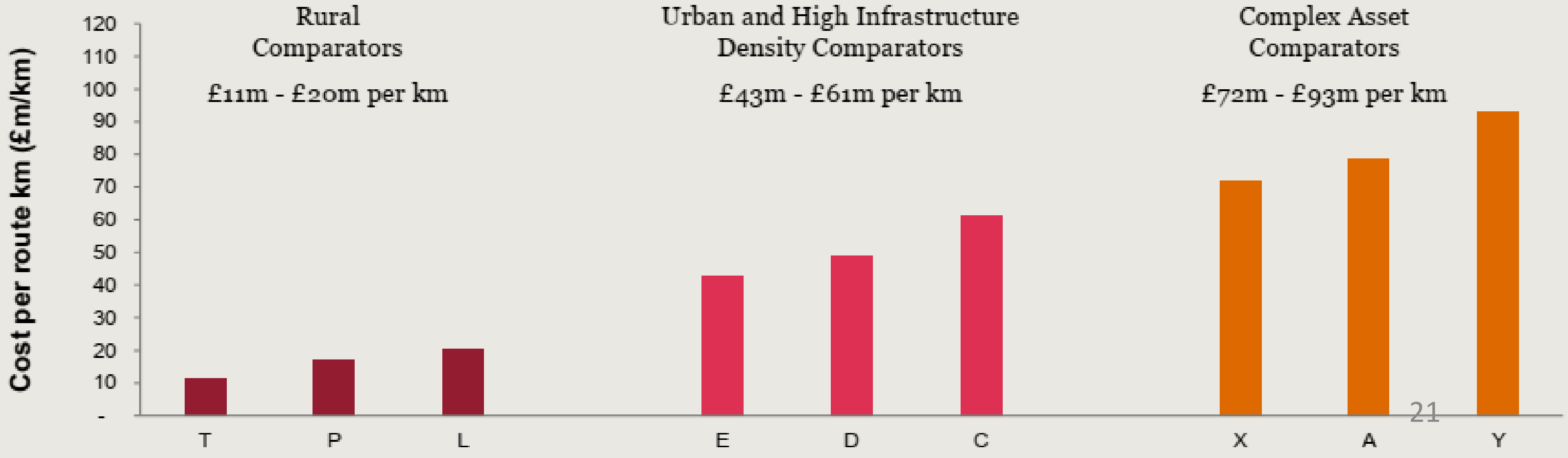
Indonesia (2016):
142,3 km (5.5 bill. USD)
= 38.6 mill.USD/km

- Comparator costs were converted into 2011 prices using GDP deflators and into GBP using Purchasing Power Parity (PPP) exchange rates.
- The majority of comparator values are based on outturn costs, with a small number based on forecasts.
- Note that the letters used to identify comparators are not consistent between different charts, to protect anonymity.

Comparator costs per kilometre



Urban, rural and complex asset sections of international high speed rail schemes



Cost comparison of international HSR

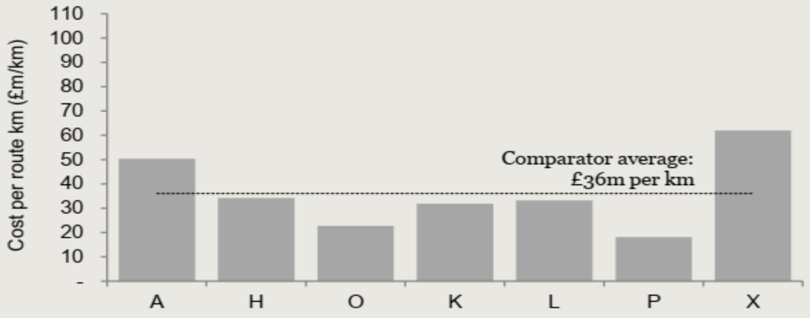
(Source: PWC, November 2016)

Civil asset costs

The major categories of civils assets on a HSR scheme are tunnels, structures and earthworks.

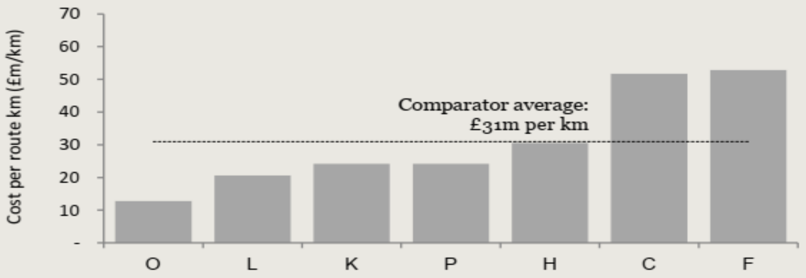
Tunnels

The costs of tunnels range from £18m per km to £62m per km, with an average of £36m per km across the comparators.



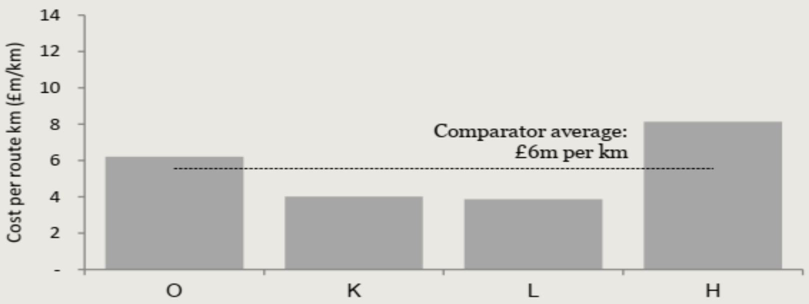
Viaducts

The costs of viaducts range from £13m per km to £53m per km, with an average of £31m per km across the comparators.



Earthworks

The costs of earthworks range from £4m per km to £8m per km, with an average of £6m per km across the comparators.



Cost comparison of international HSR

(Source: PWC, November 2016)

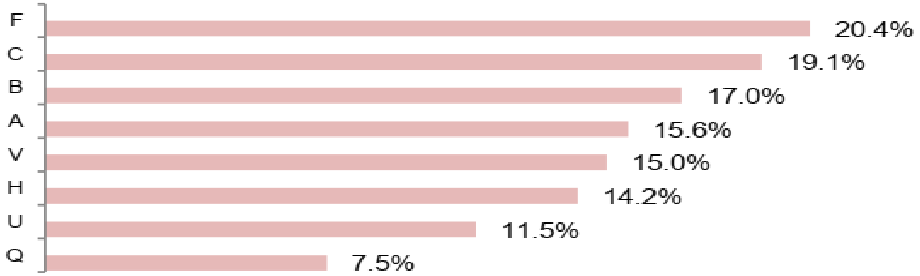
Ancillary costs

- Indirect costs
- Land and property costs
- Contingency

Indirect costs

Indirect costs include cost components like project management, design and project insurance. Reported indirect costs for the international comparators vary from 7.5% to 20.4% of construction costs.

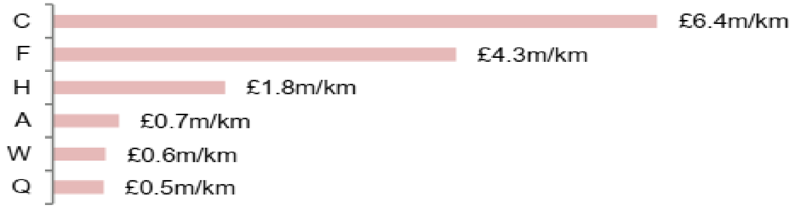
Indirects proportion on Construction Cost



Land and property costs

The costs of purchasing the land and property required to enable the railways to be constructed vary from £0.5m per km to £6.4m per km on the comparator high speed rail projects.

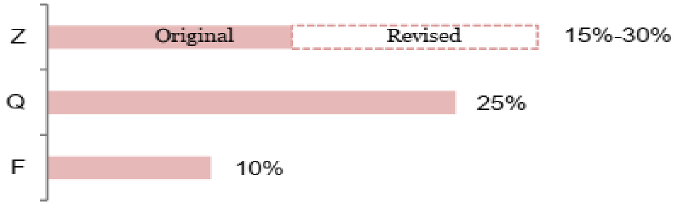
Land Cost per Route km



Contingency

Contingency allowances are set to provide cover against uncertainties in the scope of works or costs. Across the high speed rail comparators, the contingency allowances range from 10% to 30% for projects at a similar stage of estimate maturity.

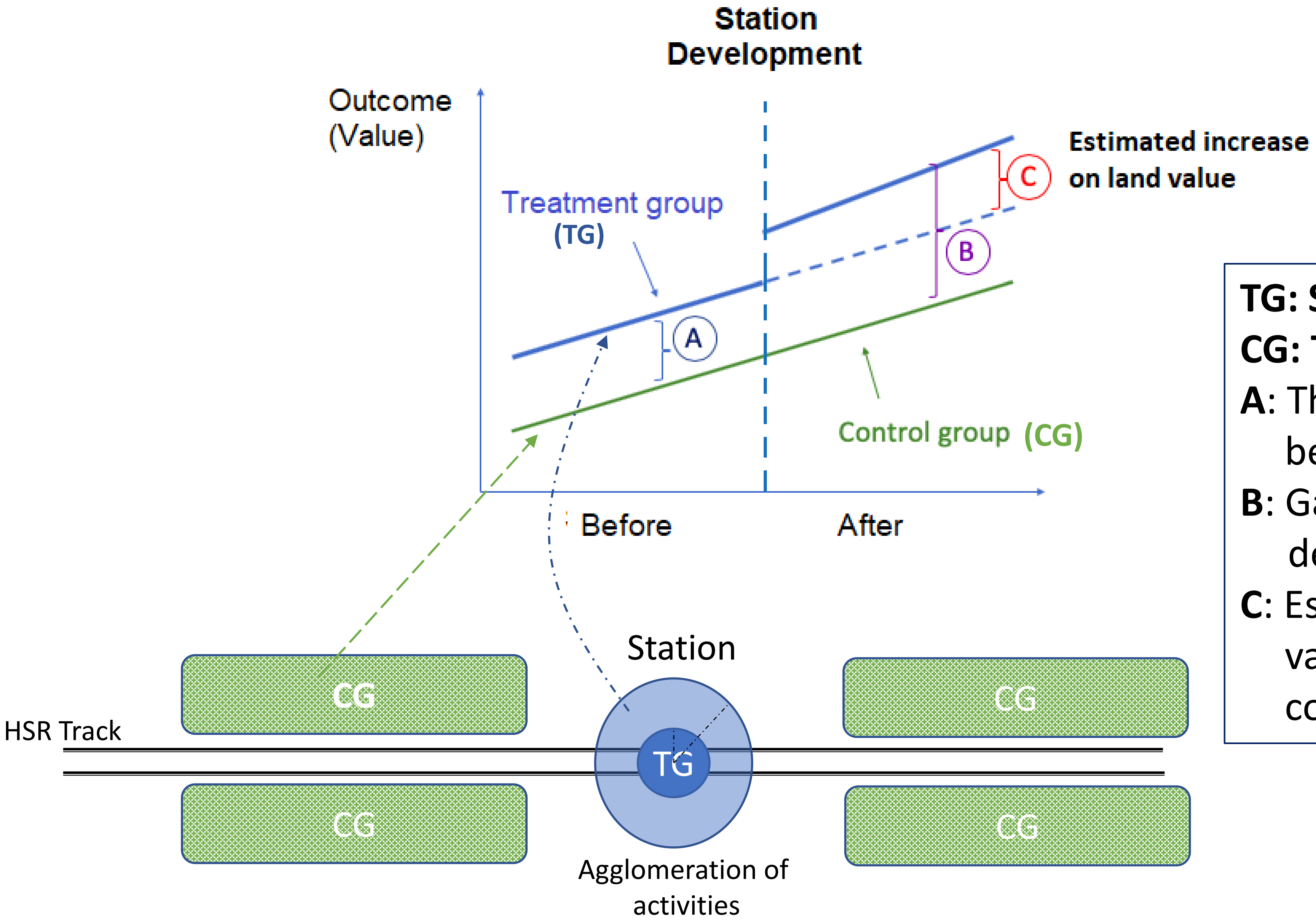
Contingency on Early Estimates



Regional Effects

- With HSR there has been an **increase in accessibility within cities**. It allows for urban regeneration, accessibility in cities near and far, and efficient inter-city relationships.
- **Better inter-city relationships** lead to high level services to companies, advanced technology, and marketing.
- The most important effect of HSR is the **increase of accessibility due to shorter travel times. HSR lines have been used to create long-distance routes** which in many cases cater to business travelers.
- **Using both longer distance and shorter distance rail** in one country allows for the **best case of economic development**, widening the labor and residential market of a metropolitan area and extending it to smaller cities.

Impacts of HSR Development on Land Value



TG: Station area

CG: The area outside the station

A: The gap between TG and CG before development

B: Gap between TG and CG after development

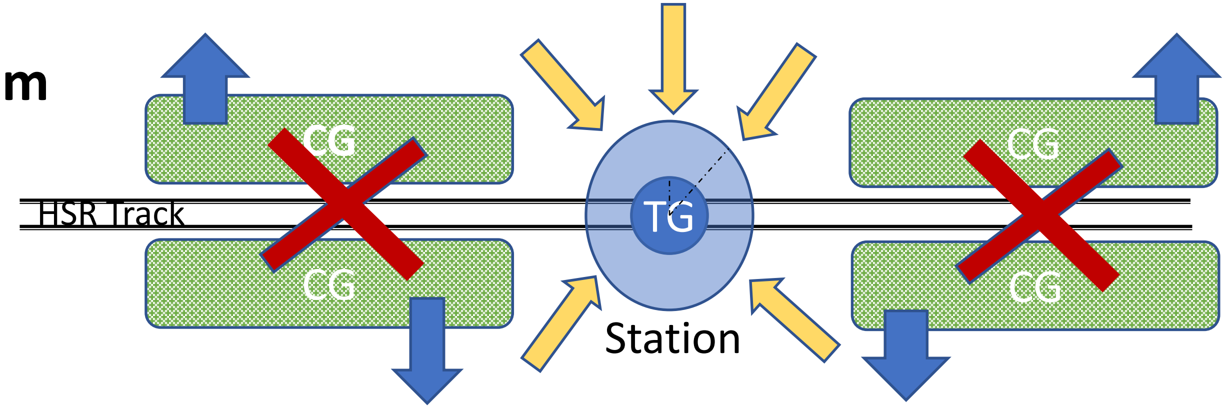
C: Estimated increase in land value, impact of station construction

Impacts of HSR Development on Spatial and Social Equity

- Impacts on **Spatial Equity**, the impacts on land-use, geographical location of activities
- Impacts on **Social Equity**, the impacts on personal, economic or social characteristics of an individual, group or region
- HSR inevitably **lead to an uneven distribution of user benefits**, in space and by network type (private and public transport).
- That distribution is one where the **maximum gap between the lowest and highest accessibility, both by mode and in space, should be limited,** while attempting to maximize average access.

Four key spatial issues facing HSR development:

1. intercity accessibility
2. intra-urban accessibility
3. new town development, and
4. social segregation.



Source: High-Speed Rail and Urban Transformation in China:The Case of Hangzhou East Rail Station, Chia Lin 2018

Closing Remarks

Sustainability of HSR Development depends on:

- **Comprehensive Planning** (short, medium, long-term) - **consistent implementation**;
- **Economy of scale** and **standardized designs** to gain optimum costs;
- **Development capacity**: adopting, innovating, localizing technology;
- **Partnerships**: international and local, state and private;
- **Project management capacity**: on-time-budget-quality-safety project delivery;
- **Service competitiveness**: speed, frequency, punctuality, comfort, safety, prices;
- **Urban connectivity**: convenient station access, integrated urban development;
- **Economic feasibility**: economic-social-environmental benefit, improved connectivity;
- **Financial viability**: fare and non-fare revenue, traffic;
- **Participation, cooperation, and dialogue** among the various stakeholders during the **decision-making process.**

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