High Speed Railway in Japan and Urban Development around the Stations

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2. Japanese experiences

   Shinkansen (HSR : High Speed Railway)
3. Suggestions for Asian Countries
4. Conclusion

Introduction

- High Speed Railway (HSR) Projects
  - '60 : Japan(1964),
  - '70 : Italy(1977),
  - '80 : France(1981),
  - '90 : Germany(1991), Spain(1992), Belgium(1997),
  - '00 : England, China(2003), Korea(2004), Taiwan(2007), Netherland, Russia, Turkey(2009)
  - '10 : Austria(2012)

HSR project are discussed in many countries :
US, Asia, Latin America, and Africa.

The Countries where High Speed Railway is operated and under construction or planning

: Operated : Under construction or planning

HSR Projects in Asian Countries

- Vietnam, Thailand, Malaysia, Indonesia, India
- Specialty of Asia for HSR
  - Population
  - Conventional railway
  - Technological background
  - Economic growth level

etc.

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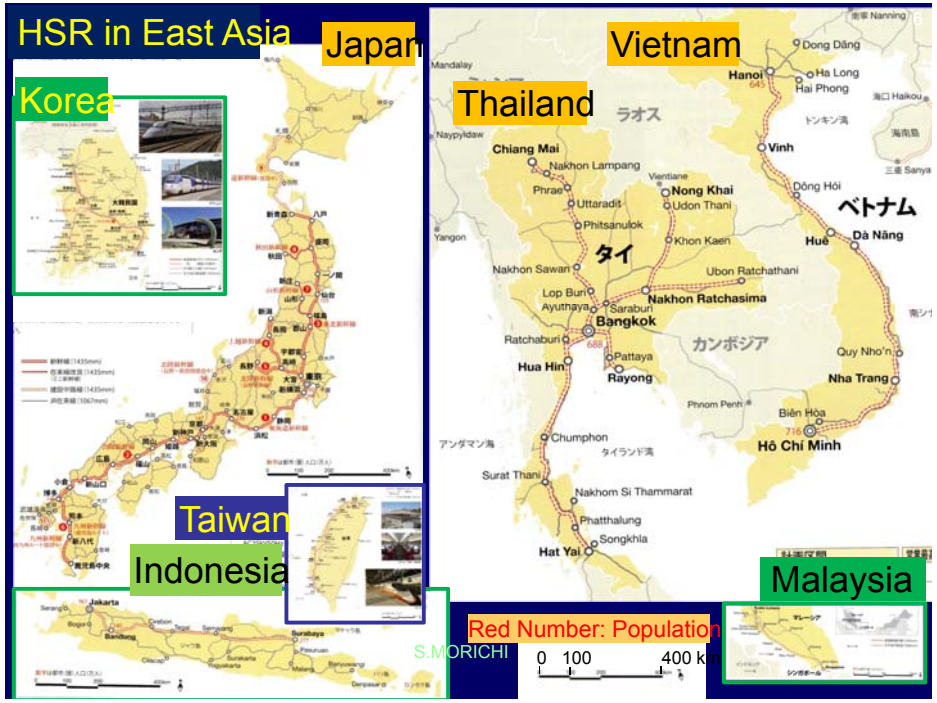

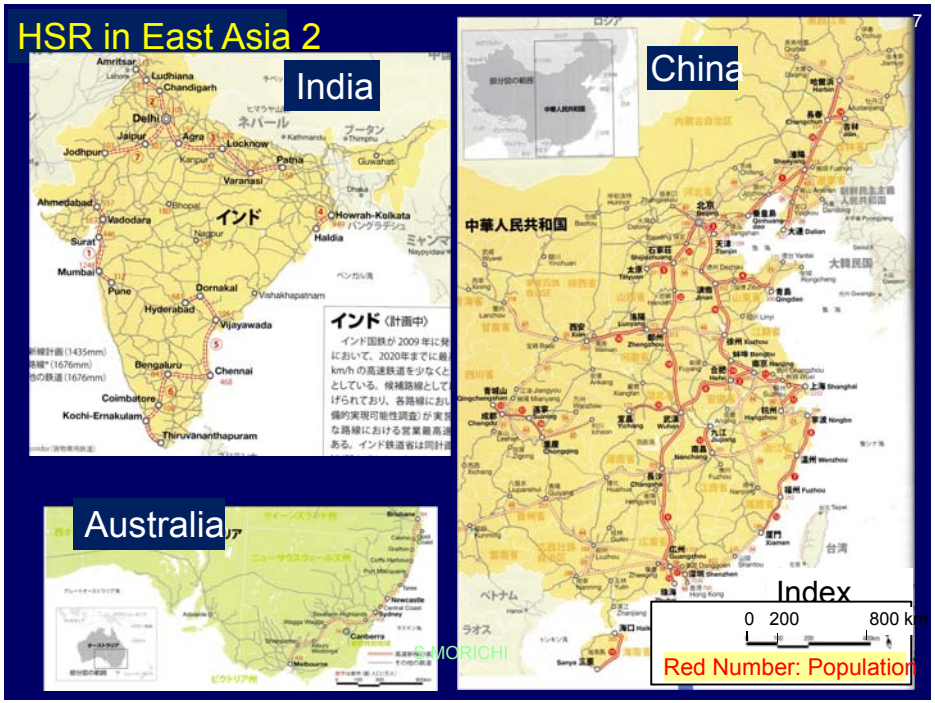

- Higher economic growth and rapid urbanization in Developing Asia → huge increase in travel demand.
- Policy focus was mainly for urban transport issues.
- Policy makers are now also facing issues related to intercity transport including HSR development, because the lack of capacity and the services are becoming a bottle neck for economic growth and international competitiveness.
- Different HSR policies in Japan, Korea, Taiwan, and China are considerable information for the decision makers in the Asia.

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2. Japanese experience

Specialties of Japanese HSR (Shinkansen)

- High modal share of HSR against car and airline
- Changing financial schemes including vertical division
- Profitability of railway operators
- No passenger's fatal accident in this 50 years
- Step by step procedure for speed-up
  210 km/h, 270 km/h, 300 km/h, 320 km/h
- Limited inter-transferability
  between HSR and conventional railway
  ; Three types of HSR projects (Appendix)
- Earthquake proof design of the system
- High efficiency for energy and environment
- High capacity and frequency (15 trains / hour)
- Several types of urban developments around station areas

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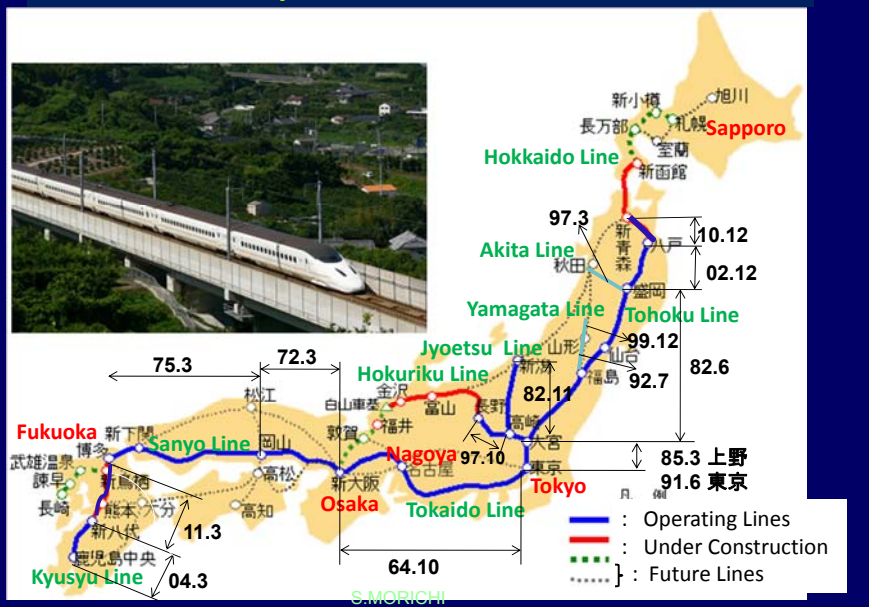
2.1 History of the construction of HSR



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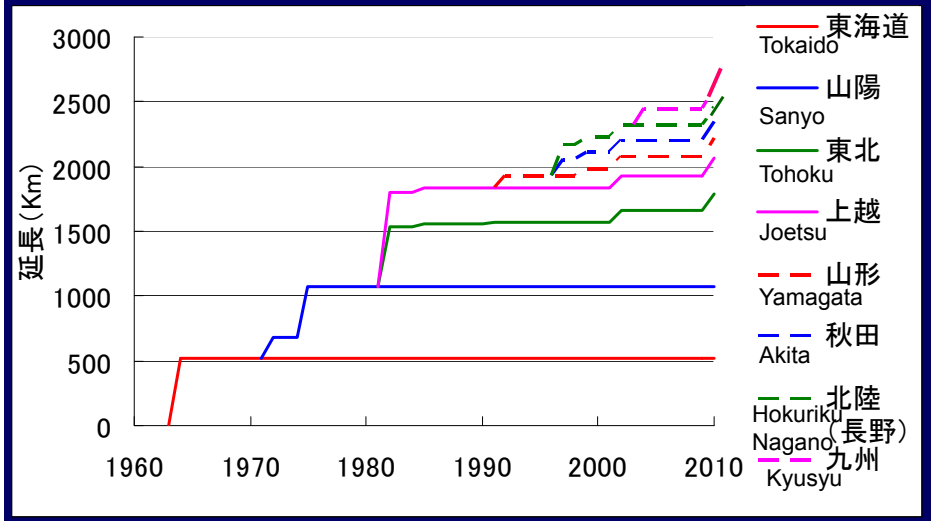
Extended distance of the Shinkansen (HSR)

Long-term efforts to expand the network in 50 years



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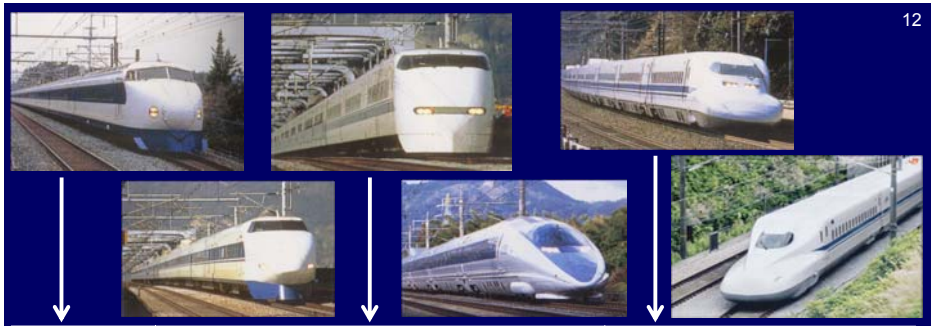

0 Series	100 Series	300 Series	500 Series	700 Series	N700 Series
1964.10	85.10	92.3	97.3	99.3	07.7
210km/h	210km/h	270km/h	270/300	270/285	270/300
Hikari		Nozomi			
Tokyo-Osaka(550 km)					
4 hrs		2 h 30m			2 h 25m

1965: 3 h 10m

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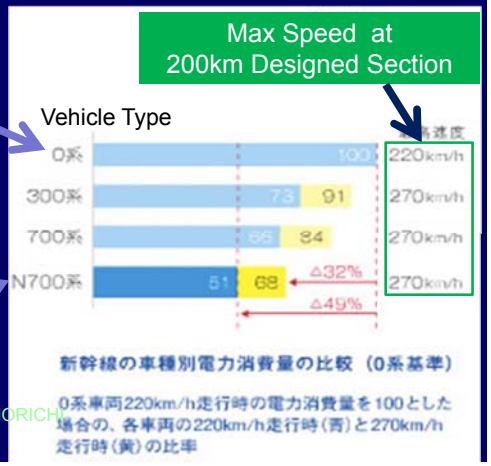
2.2 Improvement of Shinkansen Vehicle

- Weight of Vehicle
- Motor & Breaking System
- Higher Recycle rate
- Less Weld
- Less Wear Parts



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2.3 Financial policies for HSR construction

Before the privatization of JNR

Railway bond (JNR) with approval of government

After the privatization of JNR

Vertical division for the existing HSR

Nagano Line

JR 50%	Central Go. 25%	Local Go. 25%
	40%	10%

Yamagata Line

JR 30%

Local Go. 70% (Loan without interest for JR

The infrastructure of HSR was sold out to JRs

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Current Scheme : Vertical division

Cost allocation for infrastructure

Central Government		Local government
Sellout income of existing shinkansen	**Public-works Budget**	
2/3		**1/3**

※JR has to pay the user' fee of infrastructure within the profit

■Sellout income of existing shinkansen：A part of income when Shinkansen railway facilities that have already been constructed are transferred to JR East, JR Central and JR West in October, 1991. And it include front-loaded utilization of income from 2013 onward

■The local government bears 1/2 for totals of public-works allocations and the existing Shinkansen sellout income, etc.

■90% for the load of the local government is admitted the flotation of the municipal bond, and when repaying it, the tax money allocated to local governments about the half of the principal and interest total.

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2.4 Impact of High Speed Railway

- High Speed Railway brings huge impact on the region :
  - Economy ; Industry, tourism, urban development, etc
  - People's life ; job, shopping, education, etc
- Regional potential was up-grade and kept better impacts of High Speed Railway.
- High Speed Railway shifts modal split and reduces the CO2.
- High Speed Railway share might decrease without technical innovation and level up of service.

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Impacts of Shinkansen on Urban Development

Expansion of Mobility Brings Regional Competition

Commerce / Culture / Education / Medicine / Tourism

Winner in Market	Loser in Market
Increasing Economy & Population	・Passed City ・Straw Effect

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Two kinds of the Impact of High Speed Railway

- Improvement of Transport Services
  - Growth of economy
    - Increase of Investment in the region
    - increase of visitors
    - Expand of market of industries
    - increase of in-migration ; population
  - Change of people's behavior
  - Inter-regional competition
    - importance of potential in each region
- Opportunity for Regional &Urban Development

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2.5 Urban Development at HSR Station Site

1. Different Strategies by the Location of Railway Stations
   - Expansion of Existing Railway Station for HSR
   - New Station on the existing Railway
   - New HSR Station
2. Requested Development
   - New Station Building, Station Plaza & Access Road
   - Master Plan for Land Adjustment and Land-use
   - Urban Renewal Project
3. Requested Analysis
   - Feasibility
   - Consensus of Stake Holders
   - Strong Leadership

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Competitiveness of the Area

- Demand for Commercial Market
  for Business Office Space & Building
  for Condominium
- Expansion of Commercial Market Area
- Potential of New Station Area
- Increasing Visitors
- Impact of Deregulations
- Multiplier Effect of Investment and Developments

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Various types of station area developments

- Wide area urban renewal around HSR Station

  Shin-Osaka, Shin-Yokohama, Sendai, Shinagawa, Saku, etc.

- Large scale commercial building with station plaza and access road

  Kyoto, Nagoya, Sapporo, Fukuoka

- Station building with station plaza and access road

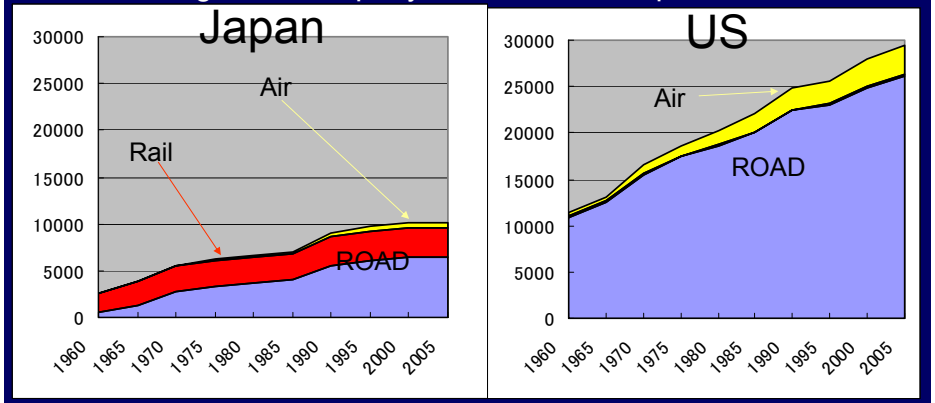
  Many examples

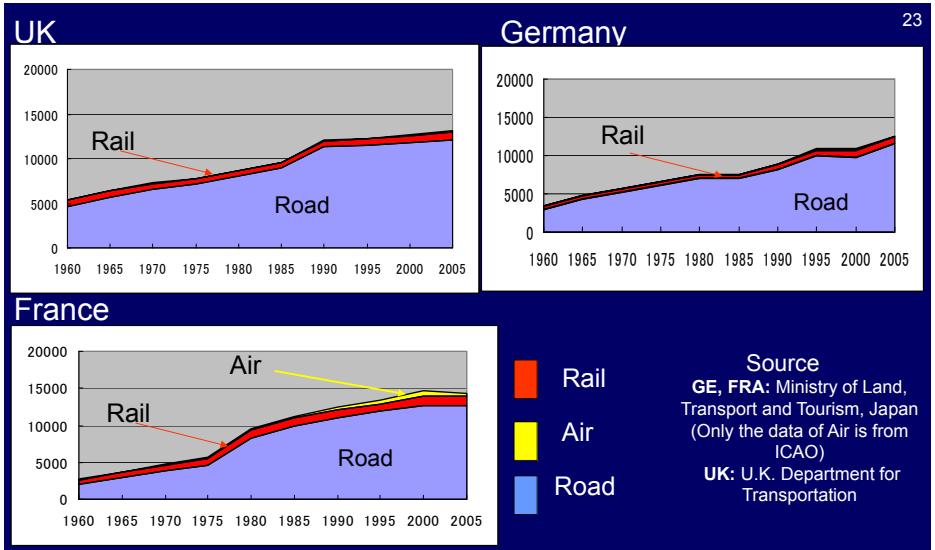
3. Suggestions for Asian Countries

3.1 Increasing Transport Demand

Intercity travel demand will increase rapidly in Asia

Passenger-km / Pop. by modes in developed countries



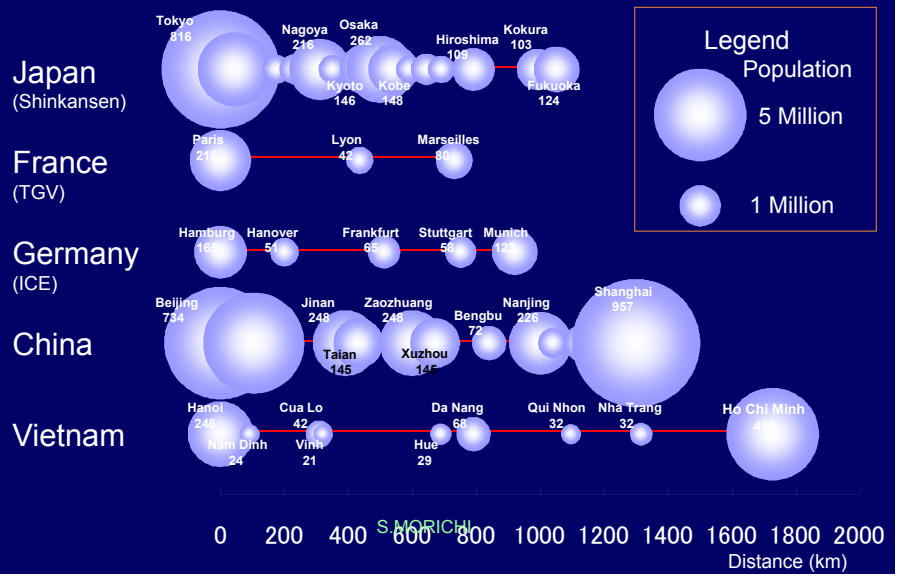


Source
GE, FRA: Ministry of Land, Transport and Tourism, Japan (Only the data of Air is from ICAO)
UK: U.K. Department for Transportation

Passenger-km / Pop. : Japan < EU < <US
Share of Rail : Japan >> EU > US

Potential Demand

Location of Cities (Population, Distance)



International patterns of travel demand

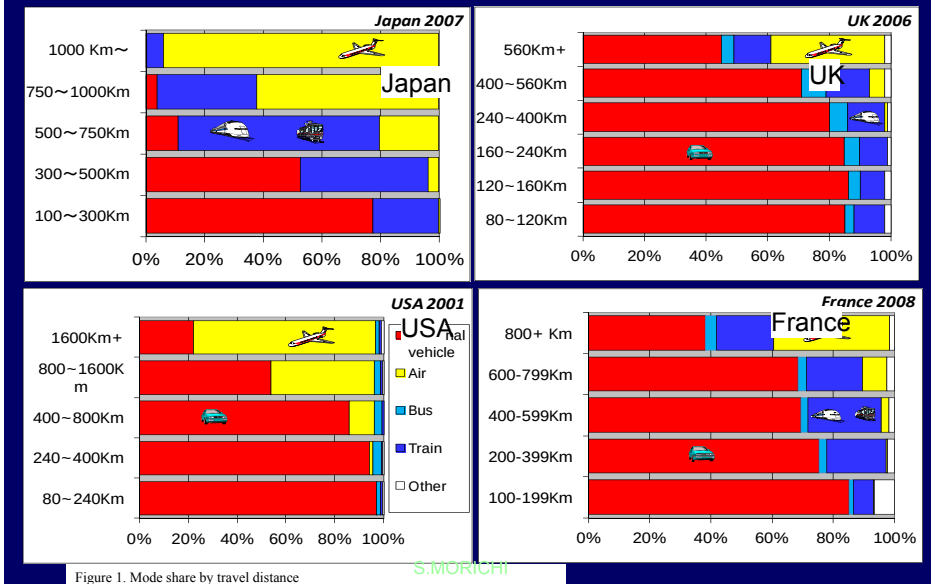


Figure 1. Mode share by travel distance
Data sources: MLIT (2009), Department for Transport (2006), BTS (2007)

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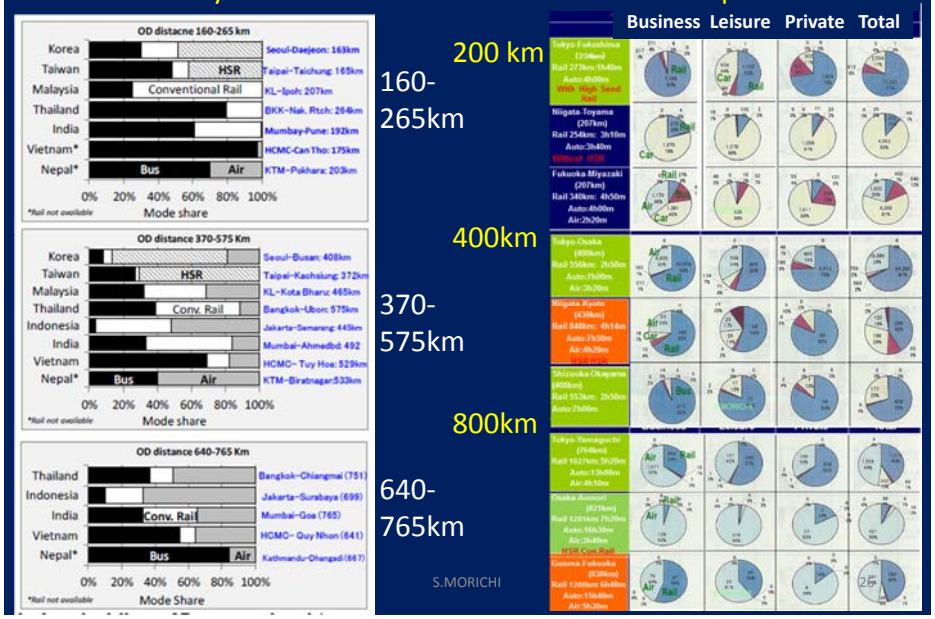
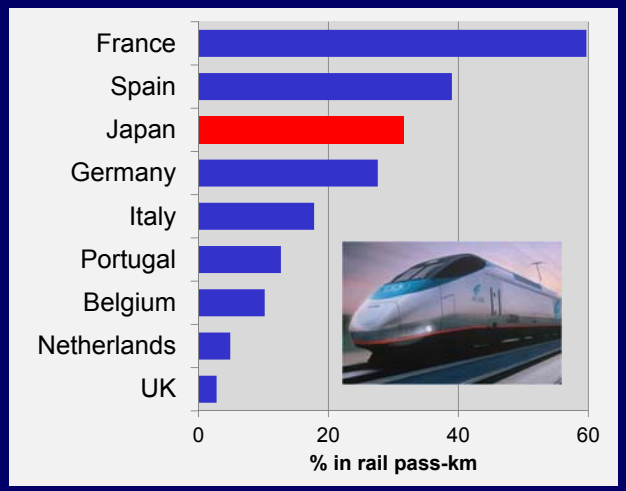
Modal share for different OD pairs



Share of High-Speed Rail in Rail passenger transport 2007



Data source: EU, MLIT
Note: Rail refers to national rail (JR for Japan); For EU, high-speed rail transport covers all traffic with high-speed rolling stock (incl. tilting trains able to run 200 km/h). This does not necessarily require high-speed infra.

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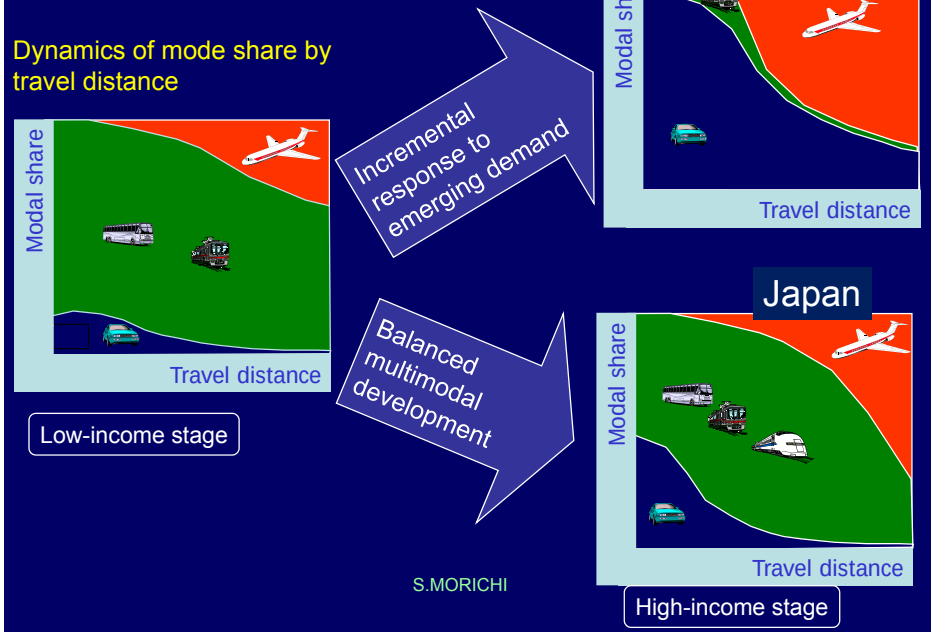
Hypothesis for Strategic Scenario

Dynamics of mode share by travel distance



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Characteristics and role of HSR

- High speed: 300-350 km / hour
- Higher capacity: about 20 - 23,000 passengers per direction per hour (15-17Trains / hour)
- Potential role for the development of regional development and secondary and tertiary cities
- Higher safety and lower CO2 emission

Competitive travel distance for HSR

- Distance range for different modes :
  computed *conceptually* and *empirically*

Access time + Terminal time +In vehicle time(Distance / Speed)

Same travel time of rail and car for distance D
Er + Tr + D/ Vr = Ec + Tc + D/Vc

For Rail and Air ・・・・・D = (Ea + Ta – Er – Tr) Va・Vr / (Vr + Va)

Assumed parameter values and competitive OD distance for each modes

	Car	Rail	Air
Access/Egress time (Ei), min	15	60	120
Terminal time (Mi), min	0	10	70
Average speed (Vi), km/h	90	240	840
Competitive OD distance niche, km	**<132**	**132-672**	**> 672**

3.2 Different Technology between HSR and Conventional Railway

Different technologies are required for safety operation of HSR.

- HSR technology should not be understood as a simple extension of conventional rail technology.
- The track and signal infrastructure, vehicles, control system and other features of HSR are entirely different
- It demands significant level of capacity building to manage and operate the system

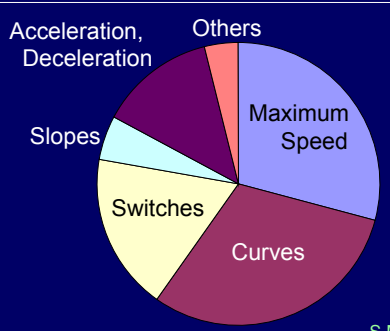
- New institutional rules, technical standards for construction and operation, and different thinking of way are required for HSR.
- Capacity building and the support system is essential.

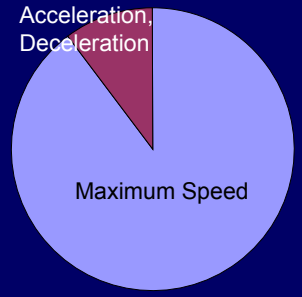
- Therefore the first stage of HSR is better to start a short distance line establishing the technology level.
- It takes many years, then the strategic planning and decision making is better to start as earlier as possible.

Constraint Factors for Railway Operating Speed

Technical constraints of conventional rail to achieve higher speed

Conventional Railway (Hakodate～Sapporo)	Shinkansen (Omiya～Morioka)
Maximum speed is possible for less than 20 % of total distance	More than 90 % of distance is operated by maximum speed





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3.3 Timing for Development of High Speed Rail

When? Funding and affordability constraints

	Japan	Korea	Taiwan
First HSR route	Tokyo-Osaka	Seoul- Busan	Taipei-Zuoying
Route length, Km	515 km	424 Km	339 Km
Project cost estimated in the year of decision	380 bil Yen	10.74 tril Won	445 bil NT$ (Without land cost)
One-way fare in the year of service opening	3000 円	44,800 Won	1,490 NT$
Project cost as percentage of GDP (year of decision)	**2.9 %** (1959)	**3.7 %** (1993)	**4.6 %** (1999)
Average fare for 500 km as % of GDP per capita (year of opening)	**1 %** (1964)	**0.32 %** (2004)	**0.38 %** (2007)

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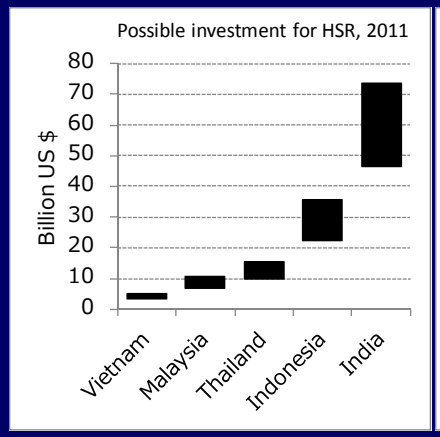
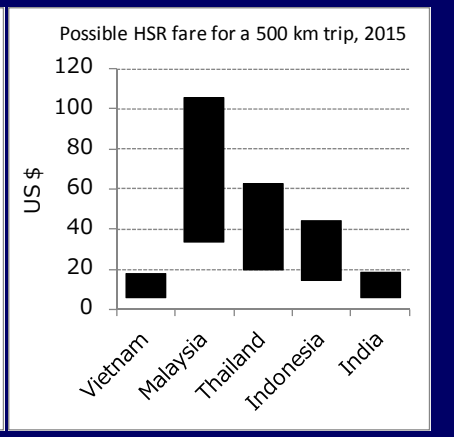
Issues and Prospects for HSR: Timing

Possible investment range and fare level for HSR in developing Asia (based on the cases of Japan, Korea and Taiwan)





However early decision making for HSR is required because the preparation is so time consuming comparing to the rapid growth of economy.

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3.4 Issues and Prospects for HSR

- Route alignment, location of station and access/egress time
  - Policy makers may have tendency of giving more priority to design speed of HSR to make the system more competitive against air mode
  - Needs straight alignment-
    - Stations need to be located away from the city centers
  - Longer access/egress time or city center station
    - Longer access/egress : weakens competitiveness of HSR
    - Station located at the existing station in city center : Speed down for limited alignment and for Lower impact on environment

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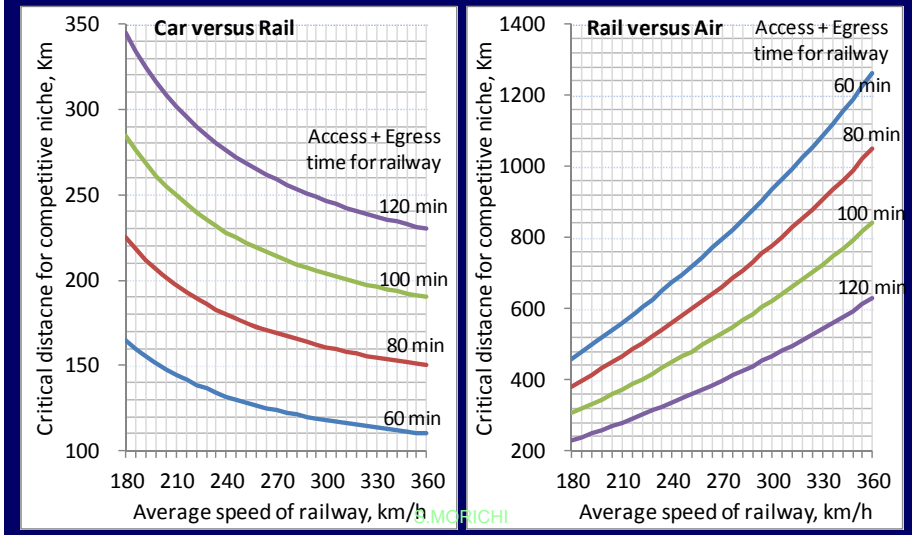
Impact of railway speed and access/egress time on the competitive niche distance for different modes



Assumption: Average speed, terminal time, access/egress time for car and air given in Table 4 in the paper

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- HSR: only for passenger or also for freight?
  - In Europe for both passenger and freight for capacity utilization :
    No simultaneous operation
  - In Asia- enough passenger demand → HSR only for passenger
  - Fright service for HSR - safety and capacity constraint
- Location of HSR stations and commercial building
- Coordination between conventional rail and HSR
  - Inter-operability
  - Coordinated operation (conventional rail as feeder rather than direct competition)
- Capacity building for HSR in developing countries

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4. Conclusion

Masterplan for HSR

- Forecast of economical growth and urbanization
- Timing of the first stage of HSR and the project, considering the financing capability, acceptable fare level, and coming capacity constraints for intercity transport for economical growth
- Early start of the preparation for the new institution, technical standards, and capacity building
- Capacity of electric power plants

e.t.c.

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HSR and Urban Development

1. Regional impacts of HSR come through demand increase of HSR
   - High modal share of HSR & the decrease by increasing time value
   - Improvement of HSR service level is required
2. Profitability of railway Co. is necessary for station area development as same as for the safety operation and the improvement of service.
3. Local government's role is essential for positive regional impacts of HSR
4. Investment by private sector is key issue for regional development
5. Institutional, financial and professional support by central government is important for total HSR project

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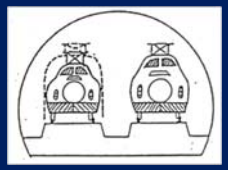
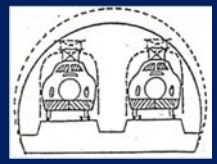
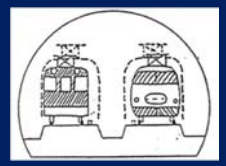
Appendix

Three kinds of Shinkansen Network Projects

Shinkansen	Yamagata & Akita	Seikan Tunnel
Shinkansen (High Speed Railway)	Improvement of existing track for direct operation from Shinkansen	Construction of narrow gauge track which will be able to transfer to the Shinkansen future
 Shinkansen	 Mini-Shinkansen	 Super express train
- Max speed 300km/h - Shinkansen standard track bed - Standard gauge(1435mm)	-Max speed 130km/h - Standard and narrow gauge on existing track bed	-Max speed 160 ~ 200km/h - Shinkansen standard track bed - Narrow gauge(1067mm)

Difference between Japan and Europe Standard

Weight of Vehicle ・・・ Design of Bridges

Taiwan HSR : Japanese vehicle & European infrastructure design

Size of Tunnel ・・・ related to construction cost and sonic boom (environmental impacts) ;

・For the social environmental impact ・・・Design of vehicle head

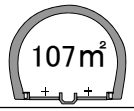
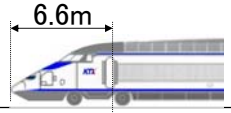
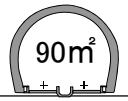
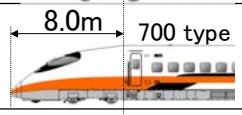
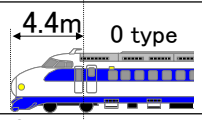
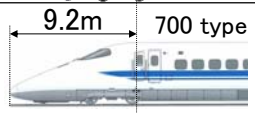
・For the passengers' environment ・・・Aeronautical design of Vehicles

Resource : Dr. Hiromasa Tanaka

Fuji River Bridge of Japan

Taiwan HSR Bridge

Size of Tunnel and Head of Vehicle (JSCE Journal Vol.92-9)

	Size of Tunnel	Head of Vehicle	Max. Speed
Korea KTX			300 km/h
Taiwan THSR			300 km/h
Japan Shinkansen			220 km/h
			285 km/h
			300 km/h

Resource : Dr. Hiromasa Tanaka

Thank you for your attention !

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