The Future of High Speed System

TC Kao
Railroad Transportation & Engineering Center (RailTEC)
Review of the Development of HSR in the past 50+ years

- HSR Has been in service since 1964.
- HSR provides a high speed, high capacity, low pollution and high energy efficiency modern transportation tool.
- 30,000 km HS lines were built. (April, 2015)
- 1.6 billions passenger per year
- 80% modal split to air transport for less than 2.5 hour train travel time
- 26 countries are operating or building their HSR systems.
Evolution of world HSR networks
How train travel time influences the market share

Source: UIC
Multi-model market share in Japan

![Market share diagram showing market share of different transportation modes in Japan, including Shinkansen, motorway, and air travel.](image-url)
UIC World HSR Congress
Round table topics

What is going to happen by 2046?
Round Table 2: What´s going to happen by 2046?

Mr Katsuji AKITA, President RTRI, Japan
Mr Volker KEFER, CEO DB Netz AG, Germany
Mr Bert KLERK, Chairman EIM, The Netherlands
Mr Luc LALLEMAND, CEO Infrabel, Belgium
Mr Hubert Du MESNIL, Chairman RFF, France
Mr Stéphane RAMBAUD-MEASSON, President Mainline & Metros, Bombardier Transport, France
Mr Joern SENS, CEO Rolling Stock Siemens Mobility Division, Germany
Mr Vipin SHARMA, Deputy Chief Executive, UIC
Mr Marcel VERSLYPE, Executive Director European Railway Agency, Belgium
10 events that may occur between now and 2046

1. From the end of oil towards clean energy

Round table 2: What’s going to happen by 2046?
10 events that may occur between now and 2046

2. New infrastructure technology and innovation

Round table 2: What’s going to happen by 2046?
10 events that may occur between now and 2046

3. Full interoperability of trains
10 events that may occur between now and 2046

4. Shell and Air France – KLM in the rail operators top ten
10 events that may occur between now and 2046

5. Complete success of Magnetic Levitation Systems

Round table 2: What’s going to happen by 2046?
10 events that may occur between now and 2046

6. Consolidation of external effects into production costs
10 events that may occur between now and 2046

7. Car ban in the centre of large cities
10 events that may occur between now and 2046

8. New communication systems reduce mobility
10 events that may occur between now and 2046

9. Widening of standard gauge
10 events that may occur between now and 2046

10. Single European Railway Authority
Future

New Technology Innovation
New Paradigm
Public Phones in THSRC Station
Phone Booth in THSRC Train
NEW Technology Innovation

• New Technology are being developed
  – New HS Systems: Faster trains, Maglev, Vacuum Train, Hyperloop,
  – New cars: Driverless car, Electric Car, Car-car communication
  – New business mode: Uber
  – Artificial Intelligence (AI): Big data, Deep learning, Machine Learning, Image recognition
  – New energy source: Shale oil, Hydrogen car,
  – Next generation robotics, Drone technology, Distributed manufacturing
Technology Innovation #1 – Driverless car
Current Development of Driverless Car
Multi-model market share
Technology Innovation #2 – Driverless Uber
Current Development of Driverless Uber
Impact of driverless Uber
Multi-model market share
Technology Innovation #3-Maglev
10 events that may occur between now and 2046

5. Complete success of Magnetic Levitation Systems

Round table 2: What´s going to happen by 2046?
The Only Commercial Maglev Line

Courtesy of China Daily
Chuo Shinkansen (中央新幹線)
Route Map

<table>
<thead>
<tr>
<th>SC Maglev line</th>
<th>Shinkansen</th>
<th>Maglev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tokyo- Nagoya</td>
<td>90min</td>
<td>40min</td>
</tr>
<tr>
<td>Tokyo- Osaka</td>
<td>150min</td>
<td>67min</td>
</tr>
<tr>
<td>Speed</td>
<td>285km/h</td>
<td>500km/h</td>
</tr>
</tbody>
</table>

Total investment: $90 billion (to Nagoya $55 billion = 192 m/ km)

(source: JR Central 2017)

© 2016 University of Illinois at Urbana-Champaign. All Rights Reserved
Economic Impact

Predicted annual benefit:
- Tokyo area: $2.6 billion
- Nagano area: $800 million
- Osaka area: $1.6 billion
- Nagoya area: $1.4 billion
- Others: $600 million

Total: $7.1 billion

Assumed rate: $1=¥100

(source: JR Central 2010)
(source: Ministry of land, infrastructure, transport and tourism 2010)
10 events that may occur between now and 2046

6. Consolidation of external effects into production costs

Round table 2: What’s going to happen by 2046?
Maglev in China

[Image of Maglev trains in China]
Multi-model market share in Japan
Vacuum Tube Train

Daryl Oster, 1999: Evacuated Tube Transport
Hyperloop

Elon Musk: Hyperloop, 2013
Technology Development #4 - Artificial Intelligence (AI)
Artificial Intelligence (AI)

- Big data & data mining
- Deep Learning
- Machine Learning
- Image recognition
AI Assisted Travel Plan

Now
• People who grow up using Mobile Devices & Apps
• Use iPhone & Starbucks apps to order a coffee.
• Use program to set thermostat
• Organize travel plan with apps from various transportation agents

Hi! Siri.

Future
• People who expect Devices & Apps to be “smart” and work for them
• Want apps to suggest a particular flavor of coffee on a particular time
• Expect program to set itself
• Expect apps to organize a “tailor made” comprehensive travel plan, with weather input, personal preference.
Emerging HSR Mobility OS

(Thomas SAUTER-SERVAES) – UIC 9th World Congress
New Paradigm
10 events that may occur between now and 2046

1. From the end of oil towards clean energy

Round table 2: What’s going to happen by 2046?
Global Warming (Climate Change)
In search of green mobility
The New Railway- We tie Europe Together
10 events that may occur between now and 2046

10. Single European Railway Authority

Round table 2: What’s going to happen by 2046?
Terrorism and Refugee
Future of Europe

Europe is at Crossroad........
Modi in Davos:
Globalization is under attack
The Belt & Road Initiative (BRI)

Unique geographical advantages

Modern port Lianyungang City is located in the north-south transition and the intersection of the inland and sea, transcontinental channels. This makes it an integral part of the China's maritime policy, and its location at the intersection of land and sea makes it an ideal location for the development of a modern port. This port has a dual function of both sea and land, allowing it to handle a wide range of goods and facilitate trade with other countries.

The port has been developed as a key node in the Belt and Road Initiative, and its strategic location makes it a crucial link in China's international trade network. The port is equipped with state-of-the-art facilities and infrastructure, allowing it to handle large volumes of cargo efficiently.

The port is also connected to other major ports and cities, facilitating the smooth flow of goods and trade. It plays a critical role in the economic development of the region, providing employment opportunities and contributing to the local economy.

In conclusion, the Lianyungang port is a key node in the Belt and Road Initiative, and its strategic location and infrastructure make it a crucial link in China's international trade network. It plays a vital role in the economic development of the region and provides employment opportunities for local residents.
Asia Infrastructure Investment Bank (AIIB)

- Jan 2016
- 84 members
- authorized capital of $100 billion
- 24 projects, $4.23 billion loan
Southeast Asia Railway network
UIC- Universities Alliance Charter for High Speed Rail
The parties
Initial members
Subject 2: 

*Virtual coupling*

**Idea:** replace the physical coupling of trainsets by a virtual one so that two trainsets can run at 300 kph or more while being separated by, let’s say, 1 metre only.

**Advantages:**
This way the track capacity could be increased not only because the stop is avoided, but also because one could imagine to have trains made up of more than 2 trainsets.

**Objective:** evaluate the implications of this idea and its feasibility.

**Other formulation of the problem:** can we suppress the signalling systems and replace them by autonomous trains in a similar way road is progressively adopting driverless cars.
Subject 3: Wireless train

Idea:
Eliminate the catenary either through powerful and high capacity batteries or by energy catchment from a wire underground (under the track)

Advantages:
Less incidents, less maintenance, wider gauge
Questions?
Subject 4:

**Rail & Urbanism**

**Idea:**
HSR is said to have a large impact on urbanism. But how can we as matter-of-factly show evidence of the benefits drawn by cities or regions from the implementation of a HSR system.

**Expectations:**
What measures would boost the urban development and the real estate management when implementing or reshuffling rail services in a city?
Vision for HSR in America
Social Economical & Environmental Impact

- Climate Change
- Petroleum Energy Resource
- Development in Clean Energy
- Urbanization
Geopolitical uncertainty

- New Geopolitical Changes - New world order
  - Terrorism
  - Refugee
  - Globalization vs. isolationism
Case-by-case transportation solution

INTEGRATOR
- Multimodal comparison
- Real-time PT information
- Smartphone ticketing

CURATOR
- Based on long-term preferences
- More parameter (weather, diary)
- Learning from customer history

INFORMATION OVERLOAD

INDIVIDUAL SOLUTION

(Thomas SAUTER-SERVAES) – UIC 9th World Congress)
Other Innovative Researches

- Virtual coupling: eliminating the headway, increase the capacities of HSR
- Wireless train: Eliminate the catenary either through powerful and high capacity batteries or by energy catchment from a wire underground (under the track)
- Platform-less Station:
Social, Economical & Environmental Evolution
Dissolution of the Soviet Union
- Euro-Asia Railway Network
Development of IT Technology

- Artificial Intelligence (AI),
- Virtual Reality Computation (VR),
- Apple pay
Pan Asia HSR Network
Urban Sprawl vs. Urbanization
Case-by case solution