

IET International Conference on Railway Engineering 2017  
Engineering the Future Railway – Where and What Next  
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Globalization and Urbanization

From the perspective of Mother Nature, there is a season for everything. The annual migration of wildlife across the grasslands in Africa, the Monarch butterflies in North America and all kinds of migratory birds over the world are vivid illustrations. Driven by the quickening pace of globalization and urbanization, humanity has come up with the greatest migrations across cities and countries.

Compared with the millions of animals moving between Tanzania and Kenya, the number of passenger trips across China during the Spring Festival is beyond imagination. Of the 3 billion passenger trips during the Spring Festival, road transport takes up 85% share of the traffic and leaves the railway and air transport with 12% and 2% respectively. While railway patronage is only one seventh of road transport, railway accounts for the biggest passenger growth over the past year.

Intercity

Family reunion during the Spring Festival is a deep rooted tradition among Chinese. Similar custom applies to other cultures and people reunite with family and friends at festive seasons, be it Christmas, Diwali, Thanksgiving or the like. Indeed, intercity transport has become a challenge for many countries and cities. As a major player for intercity transport, high speed rail development is in full swing across the globe. Apart from network expansion to cover more and farther, improvement and innovation to enable operation at higher speed and capacity is always on the agenda.

Empowered by technological advancement on propulsion systems and bogie dynamics, high speed trains worldwide are now running at 300 km/h or more, and become the choice for travel ranging from 200km to 900km. As of now, high speed rail is becoming commonplace. We can take high speed train from London to Paris in 2 hours and

Strasbourg in 6 hours, or from Beijing to Shanghai in 5 hours and Guangzhou in 8 hours. Our Guangzhou-Shenzhen-Hongkong high speed rail link is going to operate next year. By then, travelling between Hong Kong and countries along the Belt and Road Initiative would become a reality.

Over the past decade, train speed world records have been broken repeatedly. French's TGV150 clocked 574.8 km/h in April 2007 though the record was achieved under special test conditions such as shortened train, increased engine power and larger wheels. In 2010, China's new bullet train broke the world record with a train for commercial use, clocking a top speed of 486.1 km/h. In 2015, Japan set the world record of 603 km/h for its magnetic levitation train. It is just a matter of time for high speed rail to gear up and put these test runs into commercial operations.

### Inner-city

Apart from intercity transport, railway also plays an important role for inner-city commuting. The world population is projected to reach 9.9 billion in 2050, up 33% from 7.4 billion in 2016. By then, 6.6 billion people, or two-thirds of the world's population will be living in cities or urbanized areas. There will then be huge number of megacities in which efficient and reliable transport would become indispensable.

Take Hong Kong as an example, with extremely high population density but limited land resource, it is always a challenge for us to build more roads. As at 2016, we have roads, tunnels and bridges all adding up to slightly more than 2,000 km. However, we have over 730,000 licensed vehicles too. Assuming an average length of 5m per vehicle, all these vehicles would line up longer than 3,600 km. Furthermore, the average vehicular speed during peak hours could be lower than 10 km/h. It is for this very reason that Hong Kong will continue to develop a passenger transportation system centred on public transport with railway as the backbone.

Our railway network now carries over 5.5 million passenger trips per day, accounting for about 48% of all public transport. Efficient railway operation helps reduce the reliance on

road transport. The strategy not only reduces the need to have more roads, it also helps alleviate traffic congestion and lessen vehicle-induced air pollution. Our target is to further expand the metro network on the basis that 75 % of our population would have access to a railway station within 500m from their homes.

### **Sustainability**

Most of you are probably aware, 2016 was the hottest year ever recorded on Earth. As a matter of fact, climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and even more tomorrow.

The transport sector worldwide accounts for 23% of global CO<sub>2</sub> emissions and railway accounts for roughly one thirtieth of it. As such, railway contributes less than 1% of the global CO<sub>2</sub> emission but transports more than 9% of the world's passengers and goods. Even so, the industry is determined to make railway one of the greenest and most favored public transport systems over the world.

In October 2014, the International Union of Railways (UIC) presented their "Low Carbon Rail Transport Challenge" initiative. It has set three targets; improve efficiency, decarbonise power and achieve a more sustainable balance of transport modes. These targets are designed to both catalyse action and highlight progress by the rail sector. For example, to reduce specific final energy consumption from train operations by 50% by 2030, and 60% by 2050 relative to 1990, and to reduce specific average CO<sub>2</sub> emissions from train operations by 50% by 2030 and 75% by 2050 relative to 1990.

To achieve this, the global rail sector is taking action to develop electrification, improve load factors, procure more efficient rolling stock, develop energy and traffic management systems. Furthermore, regenerative braking and returning braking energy to the grid are becoming standard.

In fact, back in 2012, the UIC and the Community of European Railway and Infrastructure Companies had already outlined their “Strategy for 2030 and beyond for the European Railway Sector” to achieve carbon-free train operation by 2050. Starting from 1 January 2017, all of the electric trains of the Dutch National Railway have been powered by wind energy. In Germany, fuel-cell train will serve a 60-mile line linking Buxtehude and the beach town of Cuxhaven in 2018. The line is too far off the main network to warrant electrification, and is currently served by diesel trains. The test run was completed recently and it will be the first production hydrogen-powered trainset. The fuel cell train will be able to reach 140 km/h and travel up to 800 km on a full tank of hydrogen.

### Safety

No matter how fast the running speed, how high the carrying capacity and how green our railways are, safety always comes first. Last year in Europe, a passenger train derailed in Spain due to over-speeding. Four people were killed and 49 were injured. In India, fourteen train coaches derailed and killed 150 with another 200+ casualties. The cause of derailment was suspected to be due to rail fracture and poor track maintenance. January this year, a train crashed into a platform when entering the New York Brooklyn station, injuring more than a hundred people. At the material time, the train was travelling at a speed twice the limit.

While railway technology advancement keeps breaking speed records, automating train control and protection, enhancing safety and comfort for new trains, we must not lose sight of the existing rolling stocks and railway networks that have been running for ages and help commuting millions of people day by day. With current day technology, there is no insurmountable difficulty stopping us from retrofitting and incorporating necessary safety protection systems and devices to prevent trains from collision, derailment, and incidents arising from human errors.

As of now, railway incidents virtually happen every week and we must do something. For instance, trains could be slowed down or even stopped upon detection of speeding or better still with automatic speed control at point of turn or area with speed limit;

interlocking obstacle detection, physical barriers with train signaling at level crossing to minimize crashes and the use of GPS via mobile network to alert drivers when trains are getting close are all feasible options. These makeshift arrangements would not be able to solve all the problems. But given their low costs and easy implementation, the service wide improvement would be substantial. As far as safety enhancement is concerned, late is better than never, and some is always better than none.

### Closing

Transport infrastructure is integral to national, regional and global development. Being part and parcel of the transport infrastructure, railway will surely go faster and further to move people and goods transcending borders. Apart from contributing to global economic development, it will also bring people and cultures closer to one another. Railway is not only a transport system, it is also a vehicle for economic, environmental, political, social and technological collaboration. The history of railway is long and winding, and none of us could change it. But together, we can make it faster, greener and safer.

Thank you.

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