Driving Railway's Innovation

Part of RTRI's vision is to contribute to the further development of railways and the creation of a happier society by powerfully advancing research and development of innovative railway technologies. RTRI's president, Dr. Norimichi Kumagai will talk about the significance and the future prospect of research and development which enables further progress of railways, focusing on "digitalization of railways", "commitment to environmental and energy issues", and "further speed increase."

Innovation of Railways and the Role of R&D

Why is R&D a crucial part of innovation of Railways?

I think R&D is a key to railway innovation. Since the competition among different modes of transport is becoming intense, the pressure to reduce operational costs of railways is increasing. Moreover, due to the dwindling birth rate and an aging population, there is a serious concern about a potential shortage of skilled maintenance workers for railways. We should also continue to make every effort to keep railways safe or make them even safer. In order to cope with these difficult issues, we should invest in R&D and particularly in the development of technologies that are expected to bring breakthroughs for railway operations and achieve true innovation in the railway industry.

Dr. Norimichi Kumagai President

What do you think is important for promoting R&D which leads to innovation of railways?

RTRI is a research organization that provides technical solutions to railway organizations including railway operators, infrastructure managers, rail-related manufacturers, etc. In providing technical solutions for our clients, I think it is important to respond quickly to their needs and to social changes, and bring high-quality outcomes swiftly to the railway market. In other words, the turn-around time, from receiving requests from clients, to sending back the research results to them must be sufficiently short to meet

the clients' needs. In order to fulfill this mission, we have to improve the efficiency of R&D. We set out a new vision "RISING" in order to promote R&D leading to railway's innovation.

What do you think is required to improve the efficiency of R&D?

I would like to stress two points.

First, we need to carry out R&D swiftly by using field tests, advanced simulation and bench tests in a well-balanced manner. Among these methodologies, simulation technologies based on high-performance computing has already become an indispensable tool to improve the efficiency of R&D.

Secondly, for further promotion of R&D, railway-related organizations should share their issues, expertise and ideas and enhance collaboration in human resource development. Exchanging personnel among organizations is particularly effective for training younger researchers. Based on this idea, RTRI is promoting the secondment of researchers to foreign railway operators and universities as well as accepting researchers and trainees from overseas organizations.

Evolution of Railways by Digitalization

Could you give us some ideas how railway digitalization, which is rapidly progressing, contributes to the evolution of railways?

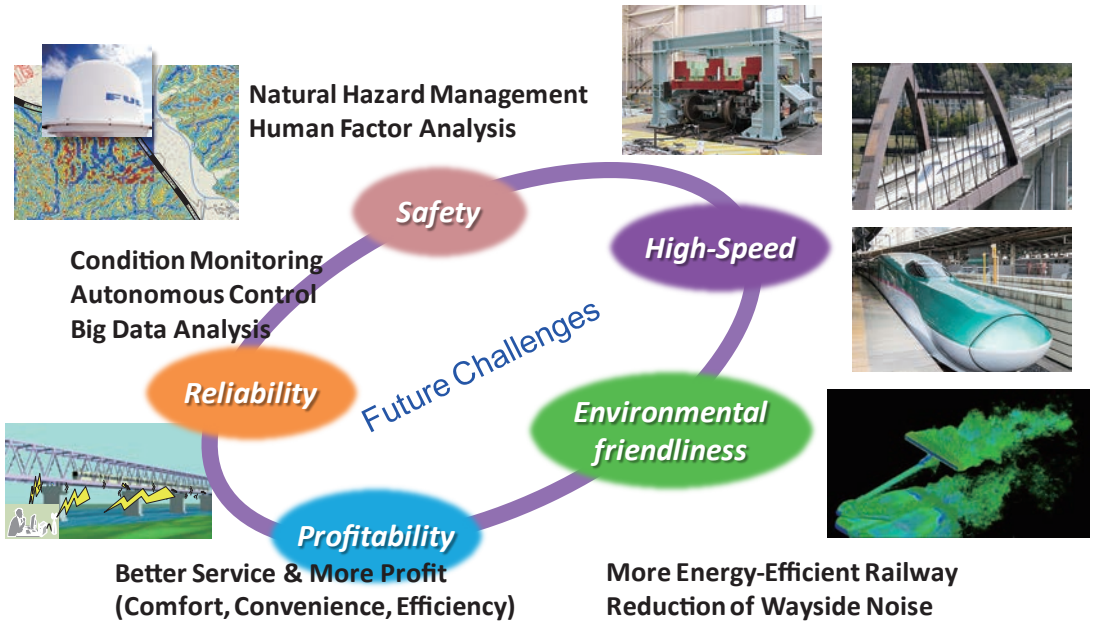
Railway digitalization leads to the improvement of safety, labor conservation and cost reduction. Emerging technologies such as artificial intelligence, image processing and big data analysis can greatly contribute to labor conservation and automation of railway operations. It is notable that these technologies have high potential to undergo rapid evolution, so that they can create higher value for railways.

It should also be pointed out that digitalization is useful for quantifying physical and physiological phenomena in an appropriate manner. Quantifying physical and physiological phenomena, which takes place in railway fields by using a variety of measuring tools and sensing technologies, will greatly contribute to the creation of measures for improving safety and efficiency of railways.

Could you please explain what we should keep in mind in promoting digitalization?

Let me give you an example. As automation progresses, human labor will be concentrated more on high-level decision making. We should note that ever-increasing importance will be attached to human error research, although the digitalization further progresses and more and more decision making is done by machines instead of by humans. Quantifying human behavior and decision making processes will be the starting point of future research into human error prevention. Among our R&D projects, RTRI has just started the basic research to develop a deeper understanding of human decision making processes using the latest brain measurement technologies in order to prevent human errors.

VISION of RTRI
RISING / Research Initiative and Strategy – Innovative, Neutral, Global –



Future Challenges for Railway Innovation

Energy and Environmental Issues

What do you think of the significance of the Paris Agreement adopted at COP21 in 2015 and its impact on railways?

At the twenty-first session of the Conference of the Parties (COP21) held in Paris last December, It was agreed that we keep the global temperature rise below 2 degrees compared to that of the Industrial Revolution Era and that every nation should evaluate the progress toward the goal of CO_2 emission reduction and revise the goal every five years.

The Japanese government has established a two-pillar program for CO_2 emission reduction in response to the outcome of the COP21: 1) further promotion of energy conservation and 2) choice of an energy source that emits less CO_2. In the transportation field, we are also required to commit ourselves to further energy conservation and CO_2 emission reduction.

The railways have a great feature of being able to carry passengers and freight with high energy efficiency and low carbon emission. In order to reduce the environmental impact of the whole transportation, however, it is important for each nation to shift as much as possible their transport demand to public transportation modes with high energy efficiency such as railways.

Could you please give us your opinion on how the railway sector should cope with energy and environmental issues?

Other modes of transport including automobiles are actively improving their environmental performance by adopting various emerging technologies. We should not be satisfied with the current status of railway's environmental performance, but further reduce energy consumption of the entire railway systems. In other words, railways should go beyond this, to the next step. The railway sector should further improve its high energy efficiency and low carbon emission, and lead the energy innovation of industries. I am confident that we can do that with the power of R&D.

For Further Speedup

Could you please give us some comments on the prospect of further speed increase on railways?

In order to establish the advantages of railways over competing transport modes such as aircraft and automobiles, we need to make railways more appealing to customers by further increasing speeds and shortening the journey time。

Currently, we are promoting research and development to raise maximum speeds of trains to 360-400 km/h for rail/wheel systems. Meanwhile, the superconducting Maglev systems can provide 500 km/h train services and will be a major driving force to innovate railways.

At the same time, a key challenge for

achieving safety is to reduce braking distances. Since, in case of earthquakes, high-speed trains need to be decelerated immediately from the speed of 360 km/h and stop completely within less than 4000 m braking distance, we have to develop non-adhesive brakes such as aerodynamic and track brakes.

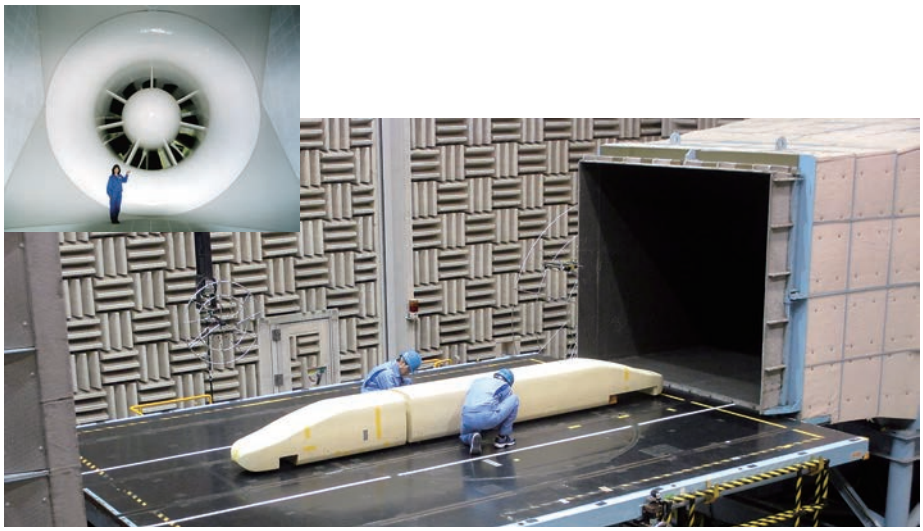
I would like to hear your comments on the technical challenges that you are facing in order to increase railway's speeds.

The biggest challenge is how to address environmental issues. As the train speeds are raised, aerodynamic impacts that affect vehicle noise and vibration are greatly intensified. For example, the energy to generate aerodynamic noise increases in proportion to the sixth power of train speed. Among many of the issues caused by aerodynamic phenomena, in particular aerodynamic noise and tunnel micro-pressure waves need to be addressed most urgently.

Please give us a specific example of a technology challenge you are addressing in developing measures to reduce noise.

It is essential to reduce noise generated by pantographs and bogies, which are major noise sources. Pantographs' shapes have already been improved so far in order to reduce noise. The lifting force acting on low-noise-type pantographs tends to fluctuate greatly, however, and the current-collecting performance in high-speed running might be damaged. So, we have to develop a technology to satisfy both the requirements for current-collecting performance and noise reduction at the same time.

Based upon these challenges, RTRI has been working for a new current-collection system which will meet further speed increase.



Preparing for a wind tunnel test

World Congress on Railway Research (WCRR)

The 11th congress of WCRR has just been held successfully. What do you think is the most significant feature of WCRR?

WCRR has evolved to be an international congress of an incomparable scale which covers wide technical areas of railways and it provides a forum to gather and share information on world railway research.

Cross-organizational, cross-border collaborations are quite important for achieving railway innovation. WCRR has already been providing good opportunities to start such collaborations.

It is important to enhance WCRR's values as a stage where world's railway research institutes will be able to understand the global trends of railway technologies, reflect them on their research activities and further develop future railway technologies.

The next WCRR will be held in Tokyo. Could you give us some comments on this?

This is the second WCRR to be held in Japan, following the first time in 1999.

Currently, Asian railways are facing an age of drastic changes. In the countries which have been achieving remarkable economic growth, urban transit systems are being developed rapidly and many countries have plans to build high-speed railways and dedicated freight railways. In Japan, we have also been steadily promoting the development of urban transit systems and expanding the Shinkansen network which will have tremendous impactst in revitalizing the Japanese local economies.

I hope that the next WCRR in Tokyo will attract railway-related people's attention to Asia, where railway industries are enjoying the most robust growth and performance in the world, ignite innovative rail research, and contribute to connecting people in different countries and communities by railway networks and attaining a happier society.