I took up my post as President of the Railway Technical Research Institute (RTRI) on June 13, 2013. I am well aware that each railway operator is now tackling various projects aimed at coping with large-scale natural disasters which could happen in the future. I feel all the more apprehensive in starting to bear this responsibility as the President of RTRI at a time when technical development is required in even greater measure in order to enhance the performance of railways even further. I am aiming at promoting innovation in railway technologies while affirming the guidelines which former President Hisashi Tarumi formulated in his quest to build up a “robust research company” in RTRI.

The prospectus of RTRI clearly states that the Institute should “challenge innovation in railway technology, from fundamental to applied research.” Here, I will introduce our roles based on this rationale, with a focus on the following three points. The first one is to promote research and development in a dynamic way so as to contribute to the development of society and to the improvement of railway operations by providing service and support to railway operators. “In a dynamic way” means being innovative while following the changes of our times and especially meeting the various needs of our society. We are going to tackle our research and development by setting a higher goal. Second, as a neutral organization responsible for railway technologies, we will respond to the confidence that society places in us. We shall do this by investigating the causes of accidents and disasters, by proposing measures to prevent accidents happening, by supporting the development of railway technology standards, by providing consultancy services, by delivering information, and by implementing other measures in a rigorous way. Our third role is to engage in activities for enhancing railway technology on a worldwide scale while taking advantage of collaborative research or other opportunities with research institutes in other countries.

We have set the following priority subjects for our research and development, and we are going to tackle them in a strategic manner. First, we have to cope with “issues related to enhanced management of railway safety.” Our goal is to bring about a railway system which can better withstand large-scale earthquakes, high winds, storms with heavy rainfall, and other natural disasters without accidents happening. Second, we have to cope with “issues related to energy saving of a railway system.” We shall direct our research at further enhancing energy efficiency, including development of a power transmission method which utilizes superconducting technology and a railway vehicle with batteries for energy storage. Thirdly, we have to cope with “issues concerning cost reduction in maintenance and replacement of facilities.” We are going to propose a method of achieving improvements at low cost, targeting the reinforcement of ground facilities and structures which show deterioration because of their age so as to use them for a longer period of time. Fourthly, we have to cope with the “challenge of increasing the speed of trains.” We are going to support a technical development project aimed at running in commercial service at 360 km/h on Shinkansen lines, while satisfying both the goals of assuring safety and protecting the environment along railway lines, including noise reduction.

In addressing these challenges, I want to emphasize the basic key concepts for research activities at RTRI: “confidence” and “quality.” We will keep our mindset tuned to provide highly reliable and high-quality solutions in return for the confidence placed in us by clients who use our research results or who ask for our consultancy services. Furthermore, taking advantage of our collective strength, namely human resources, test facilities, and accumulated data and knowhow, all the executives and regular staff of RTRI are going to spare no effort so as to present outcomes of study that are intended to be helpful for the railway business. Finally, I sincerely ask for advice and guidance from all of you who take an interest in our research work in RTRI.
Overview

Organization

Board of Trustees

Board of Directors

Auditors

Board Members

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chairman</td>
<td>Eisuke MASADA</td>
</tr>
<tr>
<td>President</td>
<td>Norimichi KUMAGAI</td>
</tr>
<tr>
<td>Vice President</td>
<td>Atsushi ICHIKAWA</td>
</tr>
<tr>
<td>Vice President</td>
<td>Kiyoshi SAWAI</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Atsushi KAWAI</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Hideyuki TAKAI</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Fuminao OKUMURA</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Makoto NOJIMA</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Takashi SAWAMOTO</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Yutaka OSADA</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Norihiko YOSHIE</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Tsuguhiro NISHIMAKI</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Toshihiko AOYAGI</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Toji HAYASE</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Yoshihiro SUDA</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Mami AOKI</td>
</tr>
<tr>
<td>Executive Director</td>
<td>Kazuaki KANASUGI</td>
</tr>
<tr>
<td>Auditor</td>
<td>Mitsutoshi INAMI</td>
</tr>
<tr>
<td>Auditor</td>
<td>Hidenori FUJII</td>
</tr>
<tr>
<td>Auditor</td>
<td>Yataro KIGUCHI</td>
</tr>
</tbody>
</table>

(As of June 13, 2013)
Overview

Income and Expenditure in FY 2012

**Human Resources**

- Number of employees: 531
- Number of PhD Degree holders: 171

(As of April 1, 2012)

**Number of On-Going Projects**

**Numbers of Themes**

- R&D for the future railways: 62
- R&D for practical technologies: 109
- Basic research for railways: 111
- Standards and surveys: 282

(As of April 1, 2012)
R&D for the Future of Railways

- Sustainability and Development of Railway Networks
- Safety and Reliability of Railway System
- Improvement of convenience
- Construction of Railway Simulators
- Innovation of Maintenance
- High-efficiency Energy Utilization
- Harmony with the environment
- Cost reduction
- Improvement of safety

Relationship with Organizations in the Research Fields
The master plan, RESEARCH 2010 was produced to describe research and development required for five years beginning in FY 2010 to effectively push ahead with activities to fulfill our commitment within various circles as a research institute capable of integrating many railway technologies. The plan is directed towards the sustainable development of railways, while considering progress in research and development in the past and changes in the circumstances surrounding the railway industry that have occurred in recent years.

In preparing this plan, we adopted basic policies on its content in view of the circumstances surrounding RTRI and railways in Japan as a whole. Regarding the management environment of JR companies, changes in their financial contribution and other movements outside the organization, we set the term of the plan at five years from FY 2010 to 2014, to account for the fact that it will take a certain length of time to carry through the “research and development for the future of railways” as referred to later, though it is difficult to correctly predict the trend in long-term future needs.

For RTRI having responsibility to society as a public-interest corporation, it is important to effectively perform its commitment to JR companies and other stakeholders through publicly disseminating research results to support railway business in the future. To this end, we shall make efforts to freshen up the targets of research and development set in the past, such as the improvement of safety and reliability, development of solutions to environmental problems on a global scale, achievement of harmony with the wayside environment, decrease system costs and the
RCH2010 - Future-Oriented Challenges (Fiscal Years 2010 - 2014)

Construction of Railway Simulators

Safety and Reliability of Railway System

High-efficiency Energy Utilization

Safety and reliability with intelligent trains

Construction of advanced, independent train safety control systems

Evaluation/measures to preserve wayside environment for high speed operation

Simulation to predict ground vibrations

Evaluate aerodynamic noise/prevention materials

Safety against meteorological disasters

● Simulation of local meteorological conditions
● Techniques to evaluate hazards
● Technologies of disaster/hazard mapping

Safety against earthquakes

● System to predict large-scale earthquakes
● Evaluation of the safety of rolling stock running during earthquakes
● Earthquake-proof technologies/measures

Improvement of safety against derailment/collision

Derailment-proof truck

Analysis of car body deformation behavior

Real-time hazard mapping

Image of the prediction of earthquake movements

Position of fault

Reduction of car energy consumption

Nano-technology metallic material

Lightweight cars made of new materials

High-efficiency car components

Decreases in car aerodynamic resistance

Simulator to evaluate energy consumption

New power supply system

● Application of superconducting technologies
● Use of semiconducting elements of low loss
● Utilization of natural energy

Simulator of power consumption in train operation

Evaluation of train operation diagrams reflecting the constraint in power supply

Design/development of a railway simulator core system

1. Car, track and train-set models
2. Simulation of phenomena between structure and wheel
3. Prototype virtual railway test track
4. Integrated air flow and aerodynamic noise simulator
5. Contact wire/pantograph simulator

Virtual railway test track

Pantograph

Track model

Car model

Analysis of three-dimensional dynamic interaction

Truck

Turbulence around structure of complicated profile

Superconducting cable

Rotor of induction motor

Contact wire/pantograph simulator

Contact wire

Integrated air flow and aerodynamic noise simulator

Prototype virtual railway test track

Simulation of phenomena between structure and wheel

Evaluation and measures of car inside-comfort

Smoothing movement at traffic nodes

New technology to monitor and maintain equipment conditions

Innovation of the structure renewal technologies

Safety and reliability with intelligent trains

Construction of advanced, independent train safety control systems

On board car sensing

Safety of workers on the track

Safety against meteorological disasters

● Simulation of local meteorological conditions
● Techniques to evaluate hazards
● Technologies of disaster/hazard mapping

Safety against earthquakes

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Annual Report 2012-2013
pursuit of comfort and convenience of passengers. As a new research challenge, we shall also aim at improving our simulation technology and try to expand our core competencies. We shall also review the organization for research and development needs and capabilities at all times to respond to the changes in the internal and external circumstances and make efforts to enhance the efficiency of our activities based on financial situations.

As development needs in the future are quite uncertain in different countries, we will review this plan regularly to take into account changes in social and economic conditions in the world.

As a guideline for carrying out research and development aimed at achieving safe and assured, highly reliable railways, with low environmental impacts and featuring low-costs and high-level convenience for customers, we set forth the following as the basic objectives of RTRI activities.

(1) Creation of new technologies aimed at sustainable development of railways
(2) Quick and correct response to meet customer needs
(3) Timely transmission and dissemination of research results
(4) Continued pursuit of railway technologies and accumulation of basic technological knowledge
(5) Effective use of this knowledge within the community of railway engineers

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(5) Effective use of this knowledge within the community of railway engineers

As development needs in the future are quite uncertain in different countries, we will review this plan regularly to take into account changes in social and economic conditions in the world.
(4) Basic Research for Railways
We believe the basic research for railways will lead to practical technologies, which are essential to solve various railway-related problems, and/or will lead to further work which we might define as “analytical research projects” and “those to explore further research.”

(5) Others
(a) Transmission of information
We will positively collect, store and transmit information on railway technologies in Japan and abroad and present the results of these research/development activities in a timely manner.

(b) International activities
We will positively participate in various international conferences, make efforts to continue to exchange information on railway technologies with overseas researchers, and send staff abroad to survey the status of the railways and technologies in foreign countries. We will also push ahead with joint research projects, exchange researchers, strengthen the cooperative relations with overseas universities and research institutes and enrich the information transmitted to other countries.

(c) Railway Technology Promotion Center
Having a bird’s eye view over the railway industry as a whole, the Railway Technology Promotion Center will assess the technological needs common to all its member railway companies and solve their problems so that they can correctly respond to the expectation of society.

(d) Railway International Standards Center
The Railway International Standards Center will integrate the discussions on wide-ranging international standards on railways, thereby contributing to railway companies as a whole, while positioning the discussions on the strategy of international standardization, reviews of international standards and collection/transmission of the information received.
In FY 2012, we pushed ahead with research and development projects on 282 themes and completed 115 projects. Major results of the research and development are shown below.

**IMPROVEMENT OF SAFETY**

- Estimation method for damage occurrence probability of vehicle derailment on structures during seismicity
  - An analysis method was developed to effectively examine train-running safety on a structure group of an entire railway line during seismicity.
  - This method can be used to evaluate the influence of various parameters, such as vehicle speed, structure characteristics and countermeasure technique on the damage occurrence probability.
Method for evaluating structural safety considering residual resistance during a major earthquake

- An analysis method was developed which makes it possible to evaluate the behavior of major deformation areas for structures as a whole or individual components.
- A proposal was made for a practical safety assessment method which could be applied for both main shock and aftershocks of a major earthquake.

![Fiber model concept](image)

Improvement of P-wave detection in earthquake early warning system

- Efficiency in detecting P-waves recorded during the 2011 off the pacific coast of Tohoku earthquake was raised from 26% to 44%.
- This allows faster estimation of earthquake magnitude, which in turn contributes to the goal of cutting the time before warnings are issued.
- Use of optimised parameters should improve the overall functionality of the earthquake early warning system.

<table>
<thead>
<tr>
<th></th>
<th>Traditional parameter ($\alpha_u=0.9998$, $\alpha_n=0.98$)</th>
<th>Proposed parameter ($\alpha_u=0.9999$, $\alpha_n=0.96$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tohoku off the pacific coast-seismic waves (2second data, within 250km of epicenter) P-wave detection rate</td>
<td>26%</td>
<td>44%</td>
</tr>
<tr>
<td>Seismic wave with instrumental seismic intensity of over 3.5 (2second data) P-wave detection rate</td>
<td>74%</td>
<td>80%</td>
</tr>
<tr>
<td>Noise wave (1second data) rejection rate</td>
<td>98%</td>
<td>95%</td>
</tr>
</tbody>
</table>

![Changes in detection function after altering parameters](image)

- Change Amplitude level (amplitude short time period average)
  - UD2(s) = (1−$\alpha_u$)×ud(s) + $\alpha_u$×UD2(s−1)
  - UD2: Amplitude level, ud: Vertical acceleration, s: Sample, $\alpha_u$: Smoothing coefficient
- Change Trigger level (constant factor of noise level)
- Change Detecting level (constant factor of noise level)
  - NL(s) = (1−$\alpha_n$)×ud(s) + $\alpha_n$×NL(s−1)
  - NL: Noise level, ud: Vertical acceleration, s: Sample, $\alpha_n$: Smoothing coefficient

1. When the amplitude level exceeds the trigger level, P-wave detection processing begins.
2. The P-wave is measured at point 2 when the amplitude level falls below the detecting level, going back in time from point 1.

![P-wave detection method](image)
Method for evaluating the danger of rainfall induced slope failure using topographical data

- A method was developed for evaluating the danger of rainfall induced landslides or embankment collapse using 3-D topographical data.
- This evaluation can be applied to pinpoint vulnerable slopes according to precipitation levels.

Archives for ground and structural data and tool for automatic analytical modeling

- Archives for subsurface ground and railway structure information were developed, whose data are associated with their latitude/longitude and railway kilometer points.
- A tool was then developed which can automatically produce analytical models for simple earthquake disaster simulation of a whole line with limited data about ground/structures.

Geological profile of earth quality, through GIS interface
Simple method for estimating snowmelt runoff volume beneath snow pack

- A simple method has been developed to determine the volume of melting snow on the snowpack surface from commonly available meteorological data. This method is required for assessing risk of total layer avalanches.
- By taking into account the infiltration process of water from melting snow into the snow layers, it was demonstrated that this method can reproduce runoff volume over time flowing beneath the snow pack.
Simple non-destructive test method for assessing surface layer permeability of concrete structures

- A simple non-destructive method has been developed for on-site assessment of the permeability of concrete surface layers which is a key influencing factor on overall resilience of steel reinforced concrete structures.
- The method is highly efficient and user-friendly and allows a single inspector to complete each assessment in a maximum of 20 minutes.

![Outline of the developed method](image1)

<table>
<thead>
<tr>
<th>Process</th>
<th>Observation of surface color and runoff</th>
<th>Absorption or running of water off surface</th>
<th>Water is sprayed onto the surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixing of target area, measurement of initial surface color</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Start</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Process is repeated. Approximately two minutes per cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observation of surface color and runoff</td>
<td></td>
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<td></td>
<td></td>
<td>Fixing of target area, measurement of initial surface color</td>
<td></td>
</tr>
</tbody>
</table>

![Repeated observation results of concrete surface layers with dense structure](image2)

- E.g. Quality can be determined by comparing the number of applications required to obtain over 90% saturation (higher number = poorer quality)

<table>
<thead>
<tr>
<th>Number of applications (No. of times)</th>
<th>Surface saturation level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
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<tr>
<td>4</td>
<td>40</td>
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<td>5</td>
<td>50</td>
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<td>6</td>
<td>60</td>
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<td>7</td>
<td>70</td>
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<td>8</td>
<td>80</td>
</tr>
<tr>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

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<tr>
<td>3</td>
<td>30</td>
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<tr>
<td>4</td>
<td>40</td>
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<td>6</td>
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<td>7</td>
<td>70</td>
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<td>8</td>
<td>80</td>
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<tr>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

Method for evaluating bogie rotational characteristics

- A device was developed for testing bogie rotational characteristics.
- By measuring the resistance moment of a bogie, it is possible to obtain a more accurate evaluation of its characteristics when running through a curve.

![Set up for examining bogie rotational characteristics](image3)

- Turntable (length: 3.5m, width: 1.9m)
- Potentiometer for detecting rotational angle
- Load cell for measuring rotational resistance
- Wheel load / lateral force measuring device
- Electric actuator

![Proposed model for finding rotational resistance moment of bogie](image4)

- Conventional model
- Proposed model
- Measured results

<table>
<thead>
<tr>
<th>Rotational resistance moment (kN•m)</th>
<th>Bogie angle (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>-5</td>
</tr>
<tr>
<td>12</td>
<td>-2.5</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

- Hysteresis
- Non-linearity
■ Practical application of a linear-motor-type rail brake

- A contactless rail brake which can also be used during power outages was developed.
- A prototype of the brake was fitted to a commercial line vehicle bogie to verify that the target braking force could be reached without a power supply.

![Linear-motor-type rail brake fitted to vehicle bogie](image1)

![Brake force characteristics for each side (left/right) of the bogie](image2)

■ Method for reducing lateral force while running through curves due to very small wheel tread irregularity

- Insight was gathered into the impact of small wheel tread irregularity on creep force characteristics
- After reproducing corrugation on the outer edge of the wheel tread, a method was proposed and verified for efficacy in field tests on RTRI premises.

![Tests on real vehicle to show effect on reducing lateral force](image3)

![Relationship between numerically calculated wheelset displacement and shape of contact surface on inner rail](image4)
High efficiency induction traction motor

- A high efficiency induction traction motor was developed, with a view to improving the energy saving performance of railway vehicles.
- 96% efficiency was achieved employing low loss material and a new rotor design.
- The new induction traction motor managed to cut electrical energy consumption by approximately 10%.

![The prototype traction motor](image1)

![The new rotor design](image2)

Model for predicting impact noise of vehicles running over rail joints

- A model for predicting the impact noise of vehicles running over rail joints was proposed; the suitability of the developed model was then verified.
- The prediction model was subsequently applied to gain insight into the contribution of each sound source to total impact noise.

![Impact noise prediction model](image3)
Production of superconducting cable for railways

- A five meter long superconducting DC 1.5kV, 8kA cable was made to meet practical specifications for use on railway lines.
- The results from electric conductivity tests verified that there were no transmission losses and that electricity could flow at over 10 kA.

![Superconducting cable](image)

![Structure of Superconducting Cable](image)

![Results of electrical current tests](image)

![Results of impact noise prediction method](image)
Reducing noise of Shinkansen train disc brake application

- Insight was gained into the squeal noise emitted by Shinkansen trains when applying their disc brakes.
- The source of squealing was determined using an evaluation method developed on a test bench.
- A number of possible means were identified to reduce braking noise.

![Graphs and images showing the relationship between CoF and noise parameters.](image)

Cementless geopolymer sleepers

- A cementless, chemically stable geopolymer concrete sleeper was developed, cutting CO₂ emissions by 80% compared with traditional fly ash intensive manufacturing processes.
- The newly developed geopolymer concrete sleeper satisfied all traditional sleeper requirements.

<table>
<thead>
<tr>
<th>Type of sleeper</th>
<th>Item</th>
<th>Rail side section</th>
<th>Sleeper middle section</th>
<th>Pull - off test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Proof load</td>
<td>Fracture load</td>
<td>Proof load</td>
</tr>
<tr>
<td>PC sleeper</td>
<td>Standard value</td>
<td>50.5</td>
<td>97.6</td>
<td>53.0</td>
</tr>
<tr>
<td></td>
<td>Tested value</td>
<td>O</td>
<td>140.0</td>
<td>O</td>
</tr>
<tr>
<td>Sleeper block</td>
<td>Standard value</td>
<td>29.4</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Tested value</td>
<td>O</td>
<td>45.0*</td>
<td>---</td>
</tr>
</tbody>
</table>

○: No cracking during proof load tests
* : Load when cracks appeared
---: Standard value or no test value

Results of functional test on geopolymer sleeper (Units: kN)
Simulation of pressure variation caused by structural vibration

- A method was developed to estimate pressure variation due to structural vibration.
- By comparing estimated and measured results, insight was gained into the rate of structural vibration contribution to total pressure variation.

Vehicle/track interaction analysis

- Vehicle: Multibody
- Track: 3D finite element method

Moving exciting force

Structural response analysis

- Vibration velocity
- 3D Finite element method
- Numerical acoustic analysis
- Boundary element method

Parameters

- Vehicle parameters
- Track parameters
- Track displacement
- Structural parameters
- Evaluation point

Special features of the analysis method

- It is possible to consider a wide range of parameters for vehicles and structures
- Structural noise up to 200 Hz can be predicted efficiently using the breakdown analysis

Simulation of pressure variation resulting from structural vibrations

Results of comparison between simulation output of floor slab vibration and actual measured results (train speed of 270 km/h)

Rate of structural vibration contribution to pressure variation

Geopolymer PC sleeper

Steel fiber reinforced geopolymer sleeper block (no rebars)
Method employing track inspection data to evaluate the internal condition of embankments

- Using 5m chord longitudinal level irregularity progression was found to be an effective indicator for assessing the internal condition of embankments on structure boundary sections.
- This indicator should make it possible to locate weaknesses in embankments and provide insight into when these weaknesses appeared.

Combination of reinforced soil structure with jointless bridge to form integrated bridges with reinforced embankments

- An integral reinforced embankment bridge was developed by combining reinforced soil structures with a jointless bridge.
- Using a full size test bridge, girders were subjected to repeated horizontal loading tests, taking temperature induced contraction and expansion into consideration, and positive and negative alternating loading tests for level two earthquake conditions, validated improved continuous stability.

Full scale mock up of reinforced embankment jointless bridge
Using recycled ballast in work method for roadbed improvement

- A roadbed improvement method was developed using grout injected recycled ballast.
- This work method reduces the impact on the environment and is more time and cost effective.

**Outline of the roadbed improvement method using discarded ballast**

**Roadbed improvement work**

**Verification of results from repeated loading tests**

**Conventional bridge issues and features of the reinforced embankment jointless bridge.**
Development of iron-based sintered metal contact strip with extended service life, for use on Shinkansen trains

- In order to extend the service life of iron-based sintered metal contact strips used on Shinkansen, a new contact strip material was developed which can reduce the wear of trolley wire while maintaining its lubricating property and wear resistance.
- Compared with existing material in use, the newly developed contact strip has approximately 5-7% more resistance to wear.

Method for reinforcing or repairing deteriorated slabs on viaducts

- A bonding method using UFC (ultra high strength fiber reinforced concrete) was developed for improving the endurance of deteriorated slabs on viaducts.
- A deck slab bonding method which reduces noise as well as increasing endurance was developed.
- Full scale tests demonstrated that both methods were practical and effective for reinforcement and repairs.
Method for improving the efficiency of integrated logic design of safety signalling equipment

• A database was proposed for the integrated logic design of safety signalling equipment.
• Based on the proposed database, a method was put forward to make integrated logic design of level crossings and ATS systems more efficient.
• Insight was gained into how to create automatic schemas of level crossing circuit diagrams and a connectivity simulation tool.
Using recorded data to analyse passenger flow when traffic is disrupted

- We have made a method to visualise passenger flow when traffic is disrupted, based on recorded transport data
- We have built a method to quantitatively predict passenger flow before and after resumption of operations

![Comparison of resulting actual number people and forecast figure for the hour following resumption of services](image)

**Results of prediction model verification tests**

![Visualisation of actual traffic management and passenger flow figures (example of metropolitan line section with parallel running lines)](image)

**Model for predicting cross-sectional number of people around time when services are to resume**

- Blocked section
- Length of downtime
- Time of occurrence (morning, middle of the day, evening)
- Level of service (number of trains) (target day / normal day)
- Area for where the forecast is being made
- Variation rate in number of passengers passing from station A to B during cross-sectional hour following reopening of operations, xx% reduction (target day / normal day)

**Case where just before services are resumed, forecast is made for the hour following reopening of operations**

- Actual figure for day 1
- Actual figure for day 2
- Forecast for day 1
- Forecast for day 2

**Example of variables used for forecasting**

- Cross-sectional number of people in each section
- Comparison of resulting actual number people and forecast figure for the hour following resumption of services
- Time of occurrence (morning, middle of the day, evening)
Silicon buffer for freight vehicles

- A silicon buffer was developed to improve the quality of freight transport by reducing movement at the front and back of wagons.
- Yard tests demonstrated the effectiveness of the device in reducing acceleration at the front and back of wagons and that its basic functions were working properly.
- Applicability and effectiveness of the device on long freight trains was verified through simulation.

The outside of the newly developed device

Structure of device (left: assembly; right: shock absorber unit)

Effect on lowering acceleration at front and back of wagon (power running 4 notches ON⇔OFF approximately every 3 seconds)
### Electro-hydraulic actuator with fail-safe function for steering system

- In order to decrease the lateral force in the transition curve, we developed an electro-hydraulic actuator with a fail-safe hydraulic circuit which can prevent the reverse steering.
- From the result of the running test on a test line, we confirmed that the new steering system was able to reduce the lateral force approximately by 60% compared with an existing steering truck.
- From the result of a bench test, we verified the fail-safe function in case of a reverse steering command.

#### Results of running tests

- **Normal steering**
  - Expand direction
  - Shorten direction

- **Reverse steering (fail)**
  - Expand direction
  - Shorten direction

#### Electro-hydraulic actuator with fail-safe function

- **Cylinder**
- **Fail-safe hydraulic circuit**
- **Motor**
- **Pump**

#### Failsafe function test results

### Pedagogical guidelines on information to be provided to travellers about resumption of train services, based on the passenger point of view

- To help staff overcome the difficult of understanding and realising how to formulate passenger announcements from the "user point of view," pedagogical material was produced to encourage responsible dissemination of information.
- Announcements improved with the teaching material; checks carried out showed that the progress achieved was still effective after 12 months.

#### Listening and watching the teaching material

- Customer survey (evidence) based strongly convincing explanation (use of RTRI own survey data)

#### Step 1 Knowledge system: providing systematic knowledge and reconstruction knowledge

- Building a positive and confident attitude towards early announcement
- Intention of early announcement behavior

#### Step 2 Emotional system: attitude change

- Subjective norm
- Early announcement behavior

#### Step 3 Behavioral system: behavior change

- Flow diagram of proposed method
Method for estimating location specific ride comfort based on compound vibration data

- In order to predict change in ride comfort due to vibrations, a method was proposed for obtaining an integrated estimate value, which is deemed to be a close representation of the physically perceived ride sensation.
- A system was then devised which analyses and gives a holistic view of ride comfort related information.

**Screen shot of teaching material - customer survey based explanation**

**Change recorded over one year of improvement in announcements**

- **Recommended announcement:** Early announcement of information regarding forecast resumption of services

  - Survey carried out four times.
  - After only the first audiovisual session
  - All four surveys conducted with 186 station staff and conductors participating in the training.

**Example of comprehensive estimated value**

- **Subjective analysis peak**
- **Peak for each indicator**

**Screenshot example of unified analytical system**

**Subjective evaluation**

- Vertical
- Lateral

**Comprehensive estimation value (dB)**

**Switch in horizontal axis denomination (time or kilometre units)**

**Display settings (scroll function)**

**Type of road bed**

- Tunnel

Chapter 1: Understanding passenger needs for information announcements in the case of suspended operations.

**Customer expectations for improvement:**

1) Too much delay in providing forecasts when trains are expected to resume service
2) Forecast times are wrong
3) Not enough information about connecting routes
4) Not enough information about possible detour options
5) Not enough information about alternative transport
6) Announcements are not frequent enough
7) The volume of announcements is not right (too loud / not loud enough)
8) Other

The greatest customer expectation was for prompter announcements about forecast times when trains would resume service.

**Survey conducted: 486 mail survey 222 internet survey**

**Selection rate of recommended announcement (%):**

- Before audiovisual training: 53%
- After three months: 70%
- After six months: 77%
- After one year: 81%

- Mail survey: 486
- Internet survey: 222

**Change recorded over one year of improvement in announcements**
**Method for dynamic analysis of wheel/rail rolling contact**

- In order to assess the state of dynamic rolling contact between the rail and the wheel, the finite element analysis program in a large scale parallel computing was developed.
- Dynamic rolling contact behavior for a single axle - single wheel model when running at high speed was calculated with high precision.

**Three-dimensional dynamic simulator of pantograph/catenary system**

- This simulator can provide accurate three-dimensional static geometry of overhead contact lines.
- Dynamic analysis of the pantograph/catenary system can be performed considering geometric non-linearity of droppers and steady arms.
Method for improving aluminium alloy properties through nanostructure control

- A thermomechanical processing method was proposed to produce a higher performing aluminium alloy for use on Shinkansen train car bodies with nanostructure control of its metallic microstructure.
- Verification was made of improved strength and resistance to corrosion.

![Graph showing material processing method and comparison between as-cast, solid solution, ageing after solid solution, and nanostructure controlled materials.](image)

- Resulting increase of yield resistance to 0.2% after applying the nanocontrol method (Al-Mg-Si: AA 6N01).
- Stress corrosion cracking resistance tests showing comparative resistance to corrosion (Al-Zn-Mg AA 7075).

![Diagram of railway technical research institute.](image)

- Example of 3D static structural calculation of compound catenary.
Public Interest Activities

1 Research and Development for Public Interest

In FY 2012 we pushed ahead with 282 research and development projects relating to the future of railways, as well as practical technologies and basic railway research. Among them, we finished 115 in 2012. 11 of them were sponsored by publicly-offered outside funding. The funds for research and development amounted to 2.58 billion yen, including 170 million yen of government subsidy and 120 million yen of outside funds. In addition, we implemented one contract-based R&D project, generating income of 120 million yen.

To improve the efficiency of research and development, we also launched 65 joint research projects with universities and other research institutes and 14 contracted research projects, while positively seeking advice and evaluation by 10 experts from outside organizations through the R&D review system.

We have disseminated the major results of our research and development through periodical publications, the RTRI Technology Forum and other seminars, and published booklets of the results of the R&D projects completed in FY 2011.

2 Surveys and Investigation

We conducted surveys on social and economic trends and on technical trends of railway technology at home and abroad in order to reflect the findings from our research and development plan. We also conducted strategic surveys such as awareness studies on railway safety and energy saving, and publicized the results through the RTRI lecture and other activities. We seconded a researcher to the International Union of Railways (UIC) in order to collect information on European railway technology and disseminated it through periodical publications.

3 Activities Involving Technical Standards

We conducted seven research and survey projects relating to technical standards which were commissioned by the national government. The income from this amounted to 100 million yen. We also carried out eight projects including development of design tools relating to technical standards.

4 Information Services

We collected information, publications and materials on railway technologies at home and abroad, and released them through the Internet and document search services. The full texts of RTRI’s periodicals are available on our website. We continued digitalizing the materials stored in the library to improve the convenience of the library.

5 Publications and Lectures

We issued periodicals “RTRI Report,” “RRR,” “QR,” “Railway Technology Avalanche” and “Information on World-Wide Railway Technologies (WRT).” We also held an RTRI Lecture entitled “Towards Further Improvement of Energy Efficiency” (452 participants), made 11 Monthly Presentations (1,022 participants), and delivered 27 Railway Technical Lectures (1,553 participants). We published a technical guidebook for Railway Structure Design Standards which was revised and released in 2012 by the Ministry of Land, Infrastructure, Transport and Tourism, and held briefing sessions for the standards in Tokyo and Osaka (484 participants).
6 Diagnosis and Guidance Services

In response to requests from railway operators, we provided consultancy services in 443 cases of rolling stock problems, power supply system problems, damage to structures caused by natural disasters, as well as technical guidance in various fields.

7 International Standardization Activities

We promoted activities relating to railway international standards in the IEC (International Electrotechnical Commission) and the ISO (International Standardization Organization) based on policies or proposals which were put forward by the Railway Technology Standardization Committee. We made efforts to collect information by exchanging opinions with related organizations in Europe and Asia. We also promoted international standardization work by arranging a meeting of the Divisional Members Meeting Council and the International Standardization Strategies and Planning Committee according to members’ needs.

Regarding IEC/TC 9 (Electric Facilities and Systems of Railways), 11 international standards were issued for which we acted as a secretariat to the National Mirror Committee. Also, energy storage system fitted to rolling stock was officially accepted as a new working topic.

Regarding ISO/TC 269 (Railway Applications) which was established in April 2012, we undertook the role of secretariat to the National Mirror Committee and initiated some international standardization work.

8 Qualification of Railway Design Engineers

We conducted the examination for railway design engineers in Tokyo and Osaka on October 28, 2012. 744 applicants took the exam and 129 passed. Moreover, in FY 2012, the exemption period for the successful first-stage test applicants was extended from one year to three years in order to make it easier for applicants to take the exam.

Commercial Projects

The revenue from contract-based, commercial activities in FY 2012 was 2.61 billion yen including income from patents. We organized eight technical seminars in order to disseminate research results and promote contract-based business, and a total of about 1,130 people from 330 companies attended.

1 Commissioned Research and Development Project

1.1 Public-Interest Projects

We implemented seven public-interest survey projects commissioned by the national government on topics that included “Design of Steel-Concrete Composite Structures,” “Displacement of a Moving Car Body on Its Suspension” and “Evaluation of Magnetic Field in the Car Interior.” We also carried out one research project entitled “Review of Evaluation Standards of Slope Damage” commissioned by the Japan Nuclear Energy Society (JNES). The income from these projects was 220 million yen.

1.2 Commercial Projects

We carried out contract-based, commercial projects related to the construction of new Shinkansen lines, the introduction of vehicle inspection systems, and the introduction of earthquake early warning systems. These were commissioned by public corporations, publicly-operated railways, JR companies, and other private companies.

Total income from commissioned projects for public-interest and commercial purposes was 2.83 billion yen, while the targeted amount was 3.43 billion yen.
Table 1 summarizes the number of customers and the amount of income from commercial projects in FY 2012. The income from JR companies, public and private railway companies and private enterprises dropped in comparison with FY 2011, while the income from public corporations increased.

Major contracted projects were a review of structure design and assessment standards of slope damage commissioned by the government, testing for a new Shinkansen project commissioned by a public corporation, introduction of rolling stock inspection systems commissioned by public railway companies, introduction of earthquake early warning systems commissioned by JR companies and seismic assessment of railway facilities commissioned by private enterprises.

1.3 Total Income
Total income from public-interest and commercial projects was 2.83 billion yen in FY 2012, 82.5% of the targeted amount of 3.43 billion yen.

2 Railway Technology Promotion Center
We sought to properly assess the technical needs common to member organizations and promoted various projects in close co-operation with railway/tramcar operators and local railway associations.

In the sphere of technical support, we dealt with 92 inquiries from members on technical subjects and carried out eight field surveys. We held forums entitled “Human Science Technology Supporting Safe and Steady Railway Transportation” in Sapporo, Tokyo, Osaka and Fukuoka, and also gave lectures at nine technical workshops organized by local railway associations. Furthermore, we compiled a textbook on rolling stock for leading engineers.

We promoted five survey projects in response to members’ requests and completed two of them including “the Survey and Research on Durability of Tunnel Repair Material.” We simplified the registration process so that the members can access the members-only page on the Center’s website more easily. Regarding the database of railway safety, we continued to add information about railway accidents and incidents.

3 Railway International Standards Center
We carried out activities relating to international railway standards of the International Electrotechnical Commission (IEC) and the International Organization for Standardization (ISO).

In July 2012, we undertook the role of secretariat to the National Mirror Committee of ISO/TC 269 and actively participated in the selection of the chairman in co-operation with overseas organizations. As a result, a Japanese chairman was elected. Furthermore, we held two human resource development seminars and made information available at home and abroad via the website and General Members Meetings.

4 Other Activities
4.1 Development of Gauge-Changing EMUs
As a member of the FGT (Free-Gauge Train) Association, we drew up plans for running tests with a new trainset fitted with improved trucks and carried out measurements during the running tests, and further improved the truck.

Apart from the project of the FGT Association, Japan Railway Construction, Transport and Technology Agency (JRTT) has been developing a new type of test train with a further reduction in weight, as a project for FY 2012 subsidized by the Ministry of Land, Infrastructure, Transportation and Tourism. JR Kyushu is in charge of design and manufacture of the vehicle. RTRI took part in the design meeting of the new test train and gave advice.

4.2 Industrial Property Rights
We made 208 patent and utility model applications (215 in FY 2011), and 241 were registered in FY 2012 (215 in FY 2011). As a result, the total number of patents and utility models owned by RTRI reached 2,108 at the end of FY 2012.
Human Resources Development

We recruited 17 new graduates and two mid-career employees to avoid generation gaps in our technology level and to maintain the R&D potential. We also re-employed 10 retiring researchers as so-called “silver workers,” to ensure the smooth transfer of technical knowledge and skills from veterans to young employees. As part of a training program for young employees, groups of four to five researchers who have two years of work experience at RTRI conducted trend surveys of advanced technologies.

In order to promote personnel exchanges, we seconded 63 researchers to other organizations, and accepted 106 in return. Among them, 32 were sent to JR companies and we accepted 59 from JR. In addition, we sent researchers to the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan Railway Construction, Transport and Technology Agency (JRTT), the New Energy and Industrial Technology Development Organization (NEDO) and the International Union of Railways (UIC), while accepting researchers from MLIT, private railway companies and railway related manufacturers. Furthermore, as a result of our efforts to strengthen relationships with universities, 11 researchers took office as visiting professors and 42 as part-time instructors. 171 of RTRI’s researchers have doctoral degrees and 77 have been qualified as Professional Engineers.

Organization

Information and communications technology has been developing at a remarkable pace in recent years. To take account of this, we merged the Signalling & Telecommunications Technology Division and the Transport Information Technology Division into the Signalling and Transportation Information Technology Division in order to establish a more efficient R&D system and to speed up decision making in this field.

We also established the Computational Mechanics Laboratory in the Railway Dynamics Division. This is in charge of acquiring, maintaining and developing advanced simulation technology in order to accelerate research and development in the field of railway simulators which can evaluate the safety, reliability, economy and convenience of railway systems.

Promotion of Corporation’s Ethical Policy

We made efforts to promote the corporation’s ethical policy, including the improvement of research ethics by providing information sessions for employees of RTRI and associated companies. We also offered education for employees through the RTRI version of the web learning system. In addition, we audited compliance with the corporation’s ethical policy.

Visitors

RTRI’s Kunitachi Head Office and the Maibara Wind Tunnel Technical Center received approximately 2,940 and 480 visitors respectively, in FY 2012. About 1,500 participants attended the RTRI Technical Forum held at the Kunitachi Head Office on August 30 and 31, and 360 participants attended the Osaka Forum on November 28 and 29. In addition, approximately 6,310 people visited RTRI’s Kunitachi Head Office on the open house day on October 13 and 5,000 people visited Maibara Wind Tunnel Technical Center on its open house days, October 6 and 7.
International Activities

Joint Research with Overseas Research Organizations

We pushed ahead with joint research projects in three framework programs with overseas railway research organizations. Each division also implemented joint research based on its own interests with railways and universities in foreign countries. In FY 2012, we started a new joint research program with Chalmers University of Technology in Sweden and the University of Bristol in the UK.

1 Joint Research with CARS and KRRI

The tripartite joint research by Japan, China and Korea has been conducted by the three parties since the two bilateral research programs (1) between RTRI and the China Academy of Railway Sciences (CARS) and (2) between RTRI and the Korea Railroad Research Institute (KRRI) were combined into a single scheme.

Aiming at sharing research results and exchanging information, joint seminars have been held since 2001 by rotation. In November 2012, we held the 11th Joint Research Seminar in Fukuoka prefecture. The research themes promoted by RTRI were “Investigation of Microorganisms in Railway Systems,” “Study of Wheel/Rail Adhesion and a Creep Test Method,” “Signal Processing of the Relationship between Track Irregularity and Vehicle Response on High Speed Lines,” “Research on the Influence of Railway Vibration on Buildings along Railroad Lines,” “Study on Monitoring Technologies for Catenary Systems” and “An Evaluation Method to Determine the Renewal Timescale for Railway Power Supply Facilities.”

2 Joint Research with SNCF

RTRI and Société Nationale des Chemins de fer Français (SNCF) have been carrying out joint research since the two parties concluded an agreement on joint research in November 1995. In September 2012, we held a collaborative research seminar at RTRI’s Kunitachi Head Office and at the Maison Franco-Japonaise. At the Maison Franco-Japonaise, a Japan-France Railway Technical Symposium was also held with co-sponsorship by RTRI, Japan-France Industrial Technical Committee and the French Embassy in Tokyo on the afternoon of the collaborative research seminar. The 6th joint research program is now in progress in the fields of “Inspection and Preventive Maintenance of Overhead Contact Wires for High-speed Railways,” “Ride Comfort for Standing Passengers,” “An Application of Wireless Sensor Networks on Railways” and “Management of Research and Development.”

3 Joint Research with RSSB

RTRI concluded an agreement on joint research with the Railway Safety and Standards Board (RSSB), in the UK in October 2008, and started joint research in December 2008. In November 2012, we had a meeting regarding the research themes for the next phase, especially for starting collaborative research regarding human sciences.

4 Joint Research with Other Research Organizations

In FY 2012, RTRI started joint research with Chalmers University of Technology in Sweden (Theme: Calculation Method of Air Flow / Fatigue Caused by Wheel-Rail Contact) and with the University of Bristol in the UK (Theme: High Precision Thrust Control by Use of an Actuator). We carried out joint research in the field of transport information technology with the Swiss Federal Railways from May 2011 to March 2013. We have also implemented a joint research program with the University of Cambridge in the UK (Theme: Status Monitoring of Facilities) since September 2006, and with Massachusetts Institute of Technology in the USA (Theme: High-temperature Superconductivity) since April 2004.
Support for WCRR

The World Congress on Railway Research (WCRR) stems from the RTRI-sponsored Tokyo international seminar held in 1992 to which RTRI invited a number of leading members in the field of research and development from major railway operators and other organizations in different countries across the world. WCRR has since developed into an international conference attended by railway engineers from around the world who place particular emphasis on research as part of their technological development. In November 2013, WCRR 2013 will be held in Sydney, Australia. To support its preparation, an RTRI executive and a director attended the Organizing Committee meeting in September 2012 (Venue: Brandenburg, Germany), and the Executive Committee meetings in May 2012 (Venue: Colorado Springs, USA) and October 2012 (Venue: Florence, Italy), as regular members. Moreover, 650 abstracts of papers were submitted for the oral and poster presentations at WCRR2013.

Co-operation with Government and Domestic Organizations

Responding to requests from the Ministry of Land, Infrastructure, Transport and Tourism and domestic organizations which support international activities, RTRI sent its researchers to various countries overseas, and in return accepted visitors and internship students from other countries. In August and September 2012, RTRI’s researchers gave lectures on rolling stock and power supply systems in Thailand.

Also, RTRI received visits from foreign students on the internship program of the University of Tokyo in July, from diplomats at the British Embassy in Japan and from representatives of Scottish Development International in November. In February 2013, RTRI received the Minister of State for Transport in the UK by request of the British Embassy in Japan.

Collection of Overseas Technical Information and Participation in International Conferences

We seconded staff to the International Union of Railways (UIC, headquarters: Paris, France) to collect information on technical research and development being undertaken by railways in Europe. We participated in the UIC Asian Regional Assembly held in Moscow, Russia, in November, in the UIC General Assembly and International Railway Research Board (IRRB) meeting held in Philadelphia in the USA in July and in Paris in December. Also, we participated in the US Transportation Research Board (TRB) meeting held in Washington DC in January 2013. As information disseminating activities, RTRI took an exhibition stand at the UIC High Speed Rail event, which was held together with the UIC General Assembly in July and also at InnoTrans 2012, which was held in Berlin, Germany in September.
International Activities

■ Dissemination of Information by Publication

In FY 2012, we issued the Newsletter “Railway Technology Avalanche” on a quarterly basis to introduce our latest R&D activities and research staffs. Also, we issued our Annual Report 2011 (English Version) using an edited version of the original Japanese-language report. Furthermore, we started providing information on QR (Quarterly Reports of RTRI) and an English version of some parts of our brochure by using the SPARK (Sharing Portal for Access to Rail Knowledge) system, which has been run by RSSB in the UK since this year.

■ Overseas Business Trips by RTRI’s Researchers and Visitors to RTRI from Overseas

The following Tables show the number of business trips made by RTRI’s researchers and the number of visitors to RTRI from overseas.

► Number of business trips by RTRI’s researchers (by purpose)

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<thead>
<tr>
<th></th>
<th>Asia</th>
<th>Europe</th>
<th>North America</th>
<th>Central and South America</th>
<th>Africa</th>
<th>Oceania</th>
<th>Others</th>
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<td>0</td>
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<td>Conference/meeting</td>
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</table>

(As of March 31, 2013)

► Number of visitors from overseas by country

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<th>Asia</th>
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<th>North America</th>
<th>Central and South America</th>
<th>Africa</th>
<th>Oceania</th>
<th>Others</th>
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</tbody>
</table>

(As of March 31, 2013)
To facilitate the smooth operation of the Railway International Standards Center, Planning and Administration Council’s meetings, which are attended by representatives of member organizations, are held a few times a year. The meetings are held to discuss important matters including business plans, budgets, business and financial reports, admissions and withdrawals of members, and other matters. To maintain close communication with members, a General Member Meeting is held a few times every year, and information and views are constantly shared among members.

1 Operation and Management

1.1 Planning and Administration Council

The business report for FY 2011 and the business plan for FY 2013 were discussed at Planning and Administration Council meetings held in May and November 2012 and in February 2013.

1.2 Settlement of Accounts in FY 2012

The total income for FY 2012 was approximately 222 million yen, including 88 million yen from membership fees, 123 million yen from JR contributions and 10 million yen of the balance carried forward from FY 2011.

The total expenditure was 187 million yen, including 60 million yen for business activities, 22 million yen as travel expenses and 102 million yen as personnel expenses.

1.3 Number of Members

There were 18 corporations and organizations joining as new entrants in FY 2012, and, as of the end of FY 2012, the total number of members is124, taking account of withdrawals and mergers.

1.4 General Member Meeting

General Member Meetings were held in August 2012 and March 2013, and discussions at the Planning and Administration Council were reported and views were exchanged among members.

2 Review of IEC and ISO Standards

Railway International Standards Center, RISC, has fulfilled the role as the National Mirror Committee of IEC/TC 9 (Technical Committee of the International Electrotechnical Commission for Electric Facilities and Systems of Railways), ISO/TC 17 (Technical Committee of the International Standardization Organization for Steel), and ISO/SC 15 (Subcommittee of ISO for Rails and Auxiliaries). Since July 2012, the Railway International Standards Center has also been acting as the ISO/TC 269 (Railway Applications) National Mirror Committee.

2.1 Role as Secretariat of ISO/TC 269 National Mirror Committee

Following the authorization of the establishment of ISO/TC 269 by the Japan Industrial Standards Committee (JISC) in April 2012, RISC started acting as the secretariat of the National Mirror Committee of ISO/TC 269 in July 2012, while a candidate recommended by Japan was accepted as chairman of ISO/TC 269, also in July 2012. RISC has continued back-up activities so that Japan can secure a position to exercise leadership in ISO/TC 269.

2.2 Activities of IEC/TC 9

Meetings of the IEC/TC 9 Mirror Committee were held in August 2012 and in March 2013, and the status of standards development was reviewed and reported. The 52nd General Assembly of IEC/TC 9 was held in Oslo, Norway on October 2 to 5, 2012 and seven persons attended from Japan. Regarding the discussions on standards, the Mirror Working Group met more than 60 times and sent 115 members of RISC and other divisions of RTRI to international conferences. Regarding IEC/TC 9, 11 standards which RISC reviewed as part of its role as secretariat of the National Mirror Committee went into effect. In addition, a standard for onboard energy storage systems proposed by Japan was approved officially.
2.3 Activities of ISO/TC 269

In September 2012, a meeting of the 1st ISO/TC 269 Mirror Committee was held, at which there were discussions about its program of activities, its organization, and the stance to be adopted for participation in the General Assembly of ISO/TC 269. The 1st General Assembly of ISO/TC 269 was held in Berlin, Germany, on October 30 and 31, 2012 and 11 persons attended from Japan. At the General Assembly, the conference language and administrative matters including the scope of work were discussed. The establishment of two ad-hoc groups, AHG02 and AHG03, was also approved there. AHG02 will prepare Japan’s proposal for Generic Standards, which are comprehensive standards covering entire railway systems, and AHG03 will prepare the proposal covering HVAC (heating, ventilation, and air-conditioning equipment). RISC organized the 2nd ISO/TC 269 Mirror Committee meeting in December 2012, and the results of the General Assembly meeting were reported there, while future strategy was also discussed.

2.4 Activities of ISO/TC 17/SC 15

The General Assembly of ISO/TC 17/SC 15 was held on June 15, 2012 and that of ISO/TC 17/SC 15/WG1 was held on June 14 and 15, 2012, both in Paris; four Japanese experts attended. RISC organized meetings of the ISO/TC 17/SC 15 Mirror Committee in June 2012, and the results of the General Assembly meeting were reported and the future stance required to deal with specific standards was discussed. Furthermore, we sent six experts of the RISC and RTRI’s other divisions to international conferences.

2.5 Activities for Other ISO Railway Standards

Regarding the review activities for other ISO railway standards which are not included in the scope of ISO/TC 269 and ISO/TC 17/SC 15, such as noise measurement, ground vibration, synthetic sleepers and fare-control systems, RISC participated in the mirror committees and sent experts to international conferences.

3 International Standardization Strategy for the Field of Railways

RISC has reviewed international standardization strategies in order to address international standardization in the field of railways.

3.1 Gathering Opinions on Strategies

(a) Divisional Members’ Meeting Council

RISC’s divisional members’ meeting council covers 10 sectors such as rolling stock, on-board electrical equipment, parts, power supply, overhead wires, signalling, station facilities, track, non-manufacturing suppliers and JR, and opinions were exchanged on the meetings about the developments in Europe and about divisional needs to introduce international standards.

(b) International Standardization Strategies and Planning Meetings

RISC held International Standardization Strategies and Planning meetings in August 2012 and January 2013, and the activities of ISO/TC 269 and RISC’s medium- to long-term activity plan were reviewed.

3.2 Review of the Proposals by Japan

Based on the discussions at the Divisional Members’ Meeting Council and International Standardization Strategies and Planning meetings, RISC proposed draft standards for wayside energy storage systems at IEC/TC 9. RISC also proposed at ISO/TC 269 that standardization work for Generic and HVAC equipment should be started.

4 Proposals for Domestic Standardization

RISC reviewed the need to set domestic standards corresponding to existing and prospective international standards, and supported the work required to incorporate them in Japanese Industrial Standards (JIS).

5 Collection, Analysis and Proposals for Information

To collect information on standards developments in Europe and other countries, we implemented the following measures:
A survey relating to features of each management system standard and its application to railways
A survey of the analysis methods for the effects of standardization in various railway fields
Translation of important overseas standards

6 Overseas Dissemination of Japanese Railway Technical Information
In order to make information on Japanese railway technology available overseas in terms of international standardization, RISC introduced Japan’s commitment to international standardization on its website in English. We also compiled an English brochure to explain the activities of RISC to overseas organizations.

7 Awareness Enhancement for International Standardization and Human Resource Development
7.1 Seminars
We introduced recent developments in international standardization at RTRI’s Monthly Lecture held in July 2012. Furthermore, we held a seminar in January 2013 to disseminate basic knowledge and the latest developments concerning international standardization.

 ► RTRI’s Monthly Lecture in July 2012

7.2 Secretariat Activities to Honour Contributors to the Standardization of Railway Technology
Japan’s Railway Technology Standardization Committee organized by the Ministry of Land, Infrastructure, Transport and Tourism honours those who have contributed to domestic and international standardization in the railway field. In 2012, RISC was commissioned by the Ministry to serve as the secretariat for the prize giving work. In FY 2012, four persons won official commendations and three were awarded encouragement prizes.

8 Promotion of Co-operation with Overseas Railway Experts
8.1 Co-operation with Railway Standards Experts Personnel in Europe
An information exchange meeting of the JISC-Comité Européen de Normalisation (CEN) was held in October 2012 in London, UK, and eight persons including the chairman of CEN/TC 256 (Railway Expert Committee) and four Japanese people attended. Furthermore, the information exchange meeting of the JISC-CENELEC’ (European Committee for Electro Technical Standardization) was held in Brussels, Belgium, in November 2012. Along with this meeting, a meeting of the JISC-CENELEC Railway Working Group meeting was held, and 11 European people including an organizer of CENELEC/TC 9X (Electrical and Electronic Applications for Railways) and eight Japanese attended, actively participating in the discussions.

8.2 Co-operation with Railway Standards Experts in Asia
In August 2012 RISC’s experts visited the Ministry of Transport and the Land Transport Agency of Singapore to exchange opinions. Also in August 2012, we held an information exchange meeting about Japan-Korea Railway Technology Standardization with KRRI (Korea Railroad Research Institute) in Japan. To co-operate with South East Asian countries, we exchanged opinions with Malaysian Railways Limited (KTMB) and State Railway of Thailand concerning co-operation procedures for international standardization activities by visiting them in December 2012. Based on the results of these activities, we will promote co-operation with Asian countries.
We renewed three items of equipment including the high-voltage electricity facility, and replaced five aging sets of apparatus including the telephone switchboard; we also implemented four safety measures. Regarding test equipment, we introduced an axle fatigue test machine using full-size axles to evaluate the propagation of cracking and the fracture process. In total, we introduced, improved, or renewed 18 test machines. Major items are summarized below.

### Full-size Axle Fatigue Test Machine

We introduced a new rotating and bending test machine which is available for full-size axle fatigue tests. This machine consists of bearing stands and holders to support the axles, an electric hydraulic actuator to apply loads and a rotational force to the axles, and an induction motor. The actuator applies loads onto the two bearing holders at the center, and the bearing stands at both ends support the loads. Bending moments can then be applied to the axle due to the force through these four stress points, as is the case on the axles of actual vehicles. The actuator is capable of exerting a maximum static load of 400 kN and a maximum dynamic load of 320 kN; the maximum speed of rotation is 1200rpm. We can obtain highly reliable fatigue strength data and damage evaluation of full-size axles.

### Torsional Shearing Test Machine for Hollow Materials

We introduced a torsional shearing test machine for hollow cylindrical track bed materials. With this machine, single or repeated twisting motions are applied to the hollow cylindrical test material while it is under vertical load. Compared with conventional triaxial tests, this machine can accurately reproduce the stress and deformation conditions of soil components in actual ground. Its loading mechanism consists of a vertical loading and a torsional loading device which are capable of low-speed and high-stress/torque loading. The test piece has an inside diameter of 120 mm, an external diameter of 200 mm, and a height of 300 mm. Larger-grain materials can also be tested.

In addition, we manufactured a PS logging device which can evaluate the hardness of the material as it changes with the loading. This device measures the velocity of the earthquake’s P wave and S wave as they propagate through the ground. We developed the test machine, focusing on precisely evaluating the strength of the ground and its deformation characteristics. The machine can handle low strain conditions such as those occurring during the construction of railway facilities or when trains are running over the ground and higher strain conditions such as those experienced during earthquakes.
<table>
<thead>
<tr>
<th>Vol. No.</th>
<th>Titles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol. 26 No. 4 (Apr. 2012)</td>
<td><strong>Special Features: Structural Technology</strong>&lt;br&gt;REVIEW: Recent Research and Development on Maintenance Technology of Railway Structures&lt;br&gt;PAPERS: Deterioration Prediction of RC Handrails Considering the Variety of Damage Factor&lt;br&gt;PAPERS: Improvement of Deformation Performance of Reinforced Concrete Columns with Small Shear-span Ratio by Using the Steel Jacketing&lt;br&gt;PAPERS: Development of Structural Improvement Composing with Concrete Slabs for Renewal of Existing Railway Steel Bridges&lt;br&gt;PAPERS: Stability Inspection of Existing Retaining Walls&lt;br&gt;PAPERS: Reinforcement of Old-type Bridges against Earthquake by Integrating Railway Steel Girder, Abutments and Embankment&lt;br&gt;PAPERS: Estimation Method of Falling of Concrete Piece from Tunnel Lining&lt;br&gt;PAPERS: An Effect and a Design Method of Rock Bolts as Countermeasures for Roadbed Heaving of Mountain Tunnels&lt;br&gt;PAPERS: Health Monitoring System for Finishing Materials of Station Facilities</td>
</tr>
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<td>Vol. No.</td>
<td>Titles</td>
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<tr>
<td>Vol. 26 No. 10 (Oct. 2012)</td>
<td>Special Features: Vehicle Technology&lt;br&gt;REVIEW: Recent Topics on Vehicle Technologies&lt;br&gt;PAPERS: Safety Evaluation of Railway Vehicle Against Crosswind Applying a Full-Vehicle Model&lt;br&gt;PAPERS: Experiments and Simulations of 1 to 10 Scale Model Vehicle Being on Vibrating Track&lt;br&gt;PAPERS: Fault Detection of Vertical Dampers of Railway Vehicles Based on Phase Difference of Vibrations&lt;br&gt;PAPERS: The Influence of the Details of Reinforcement Arrangement on Deformation Performance of Reinforcement Concrete Members&lt;br&gt;PAPERS: Repair Method and Restorability Assessment Method of Damaged Concrete Filled Tubular Steel Members&lt;br&gt;OTHER REVIEWS: Seismic Design Procedure of Reinforced-soil Bridge Abutment and an Example of Its Performance Verification&lt;br&gt;OTHER REVIEWS: Seismic Design Procedure of Conventional Type Bridge Abutment and an Example of Its Performance Verification</td>
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RESEARCH REPORT: Trend of Modularity in Railway System
Quarterly Report (QR)

<table>
<thead>
<tr>
<th>Vol. No.</th>
<th>Titles</th>
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</table>

Newsletter, “Railway Technology Avalanche”

<table>
<thead>
<tr>
<th>No.</th>
<th>Titles</th>
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</thead>
<tbody>
<tr>
<td>No.39 (Jul. 2012)</td>
<td>RTRI Celebrates the 25th Anniversary of its Foundation A Commemorative Symposium The 25th Anniversary of the Foundation of RTRI Preparing to Meet the Challenges of the Next 25 Years Development of a New Railway Simulator Development of an Earthquake Disaster Simulator for Railways A Study on Intelligent Trains to Improve Safety and Reliability of Operation A Technology to Restore Deteriorated Steel Bridges-Development of Bridges Integrated with Nail-Reinforced Soils-</td>
</tr>
<tr>
<td>No.40 (Sep. 2012)</td>
<td>Viewpoints on the New Railway Age - Promotion of Basic Research - High-Speed Rail Development for the Next Generation UIC Highspeed 2012 held in Philadelphia, USA in July 2012 Diagnostic Technology to Improve the Upkeep and Maintenance of Railway Tunnels Development of a System to Support Energy Saving Train Operation Evaluating Train Rescheduling Methods to Reflect Passenger Dissatisfaction Factors that Influence the Adhesion Coefficient between Wheel and Rail</td>
</tr>
<tr>
<td>No.42 (Mar. 2013)</td>
<td>ISO Institutes New Technical Committee ISO/TC 269 Railway Applications What Can We Do to Develop Railway Technologies in Asia?- Railway Technical Discussion at RTRI on October 25, 2012 Development of a Fault Point Locator for the Freight Train Command Line Development of a Switch Rail with Improved Wear Resistance A Technique to Detect Overheated Switchboards with a Gas Density Detector Measurement of Wheel Flange/Rail Gauge Corner Contact Conditions</td>
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Lectures

**RTRI Lecture**

<table>
<thead>
<tr>
<th>Special address</th>
<th>Japan’s energy vision and the latest technology</th>
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</thead>
<tbody>
<tr>
<td>Keynote address</td>
<td>RTRI’s efforts for improving energy efficiency</td>
</tr>
<tr>
<td>General address</td>
<td>• Railways and energy</td>
</tr>
<tr>
<td></td>
<td>• Optimization of energy use by modal shift</td>
</tr>
<tr>
<td></td>
<td>• Optimization of energy use in the rolling stock field</td>
</tr>
<tr>
<td></td>
<td>• Optimization of energy use in stations</td>
</tr>
<tr>
<td></td>
<td>• Optimization of energy use in the power supply field</td>
</tr>
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</table>

**Monthly Presentation**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Date</th>
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<tbody>
<tr>
<td>Recent research and development on rolling stock technologies</td>
<td>April 18, 2012</td>
</tr>
<tr>
<td>Recent research and development on disaster prevention technologies</td>
<td>May 11, 2012</td>
</tr>
<tr>
<td>Recent research and development on transportation planning and information technology</td>
<td>June 25, 2012</td>
</tr>
<tr>
<td>Trends in recent railway international standards</td>
<td>July 18, 2012</td>
</tr>
<tr>
<td>Recent research and development on power technologies</td>
<td>August 9, 2012</td>
</tr>
<tr>
<td>Recent research and development on track technologies</td>
<td>September 25, 2012</td>
</tr>
<tr>
<td>Recent research and development on earthquakes and structural engineering</td>
<td>October 17, 2012</td>
</tr>
<tr>
<td>Recent research and development on human sciences</td>
<td>December 18, 2012</td>
</tr>
<tr>
<td>Recent research and development on rolling stock technologies</td>
<td>January 11, 2013</td>
</tr>
<tr>
<td>Research and Development situation on railway simulators</td>
<td>February 13, 2013</td>
</tr>
</tbody>
</table>

**Statistics**

**Record of Recognition**

<table>
<thead>
<tr>
<th>Title</th>
<th>Name of awardee</th>
<th>Category of prize</th>
<th>Date of reward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commendation by Minister of Education, Culture, Sports Science and Technology, Japan</td>
<td>Ken Watanabe</td>
<td>Research into an evaluation method for determining the progress of destruction of concrete components</td>
<td>April 17, 2012</td>
</tr>
<tr>
<td>Medal with Yellow Ribbon</td>
<td>Kimiaki Sasaki</td>
<td>Idea of inventing semi-active vibration control system for railway rolling stock</td>
<td>April 29, 2012</td>
</tr>
</tbody>
</table>

**Commending organizations**

- **Academic societies**
  - Japan Society of Refrigerating and Air Conditioning Engineers, Academic Award
  - Japan Society for Safety Engineering, 2011 Encouragement Award
  - Japan Concrete Institute, 2012 Technology Award
  - Japan Ergonomics Society, 2012 Ergonomics Good Practice Award, First Prize
  - The Japanese Geotechnical Society, 2011 Paper Award
  - The Japanese Geotechnical Society, 2011 Research Encouragement Award
  - Japan Society of Civil Engineers, 2011 Yoshida Research Encouragement Award
  - Japan Society of Civil Engineers, 2011 Paper Award
  - Japan Society of Civil Engineers, 2011 Technology Award
  - Japan Concrete Institute, the 34th Concrete Engineering Annual Paper Encouragement Award for a Lecture
  - Japan Society of Civil Engineers, Paper Encouragement Award
  - The Institute of Electrical Engineers of Japan, Industry Application Division, Division Paper Award
  - The 2nd Asian Clay Conference Award for The Best Poster
  - The Clay Science Society of Japan, Technology Award
  - STEH’12 Best Paper Award
  - The Society of Materials Science, Japan, the 12th Symposium of Repair, Reinforcement, Upgrade of Concrete Structures, Best Paper Award
  - 2012 IEEE RFID-TA Technology & Applications Best Paper Award
  - Japan Chapter of International Geosynthetics Society, 2012 Paper Encouragement Award
  - International Society for Rock Mechanics, the 13th Rock Mechanics Symposium, Best Paper Award

- **Associations**
  - Japan Railway Electrical Engineering Association, Technology Award, Best Paper Award
  - Japan Railway Electrical Engineering Association, Association Journal Best Work Award
  - Congress of Japan Railway Cybernetics, Best Paper Award
  - Japan Railway Engineer’s Association, Sakata Memorial Prize, Best Paper Award
  - The Ceramic Society of Japan, Technology Award
Patents in Possession

Regarding the patents applied for, we do not claim examination of those with little operability or for which improvements have been applied for registration.

We also scrutinized the patents in possession with respect to the necessity of holding or possibility of abandonment. We positively disclaimed the patents for which 10 years or over have passed after registration and little operability is expected.

As of FY 2012, the results of the scrutiny are as follows.

Newly registered patents, etc.
Patents, 239; Design patents, 2; Total, 241

Patents of which the rights have expired
Patents, 12

Abandoned patents, etc.
Patents, 151; Design patents, 0; Total, 151

Consequently, we have 2,127 registered industrial property rights (including 19 trademarks).

<table>
<thead>
<tr>
<th>Category of prize</th>
<th>Commending organizations</th>
<th>Associations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reward for Outstanding Research and Development</td>
<td>• Implementation of low-cost vibration control equipment which improves ride comfort</td>
<td>• An Administration Committee of Railway Freight Promotion Encouragement Award, Encouragement Award</td>
</tr>
<tr>
<td></td>
<td>• Evaluation of the stability of a slope during an earthquake by use of a large scale shaking table test and large deformation</td>
<td>• The Promotion Foundation for Electrical Science and Engineering, Committee of the Promotion Foundation for Electrical Science and Engineering, Technology Encouragement Award</td>
</tr>
<tr>
<td></td>
<td>• Development of a flexible structured composite brake block</td>
<td></td>
</tr>
<tr>
<td>Reward for Outstanding Service Achievement</td>
<td>• Technical guidance relating to the improvement of running safety on freight vehicles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Introduction of an earthquake information monitoring system on the Shinkansen</td>
<td></td>
</tr>
<tr>
<td>Prize for Outstanding Research and Development</td>
<td>• Development of a safety evaluation method for ballasted track in areas adjacent to structures during earthquakes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Development of a bridge with reinforced embankment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• A method of producing high-quality panoramic pictures which is applicable to long and massive structures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Development of small magnets which are made of high-temperature superconductive materials</td>
<td></td>
</tr>
<tr>
<td>Prize for Outstanding Service Achievement</td>
<td>• Activities of support divisions in dealing with the Great East Japan Earthquake</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Activities of a committee and conducting a survey on reviewing the standard of vision for drivers/confirmation tests for signals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Working out and dissemination of standards for structural foundations and soil retaining structures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Revision of a section of Railway Research Review and change of editorial system</td>
<td></td>
</tr>
<tr>
<td>Prize for Encouragement of Research and Development</td>
<td>• A high-precision forecasting method for tunnel sonic booms based on logical analysis of the compression wave</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• A stochastic earthquake forecasting method considering the seismic center and position characteristics</td>
<td></td>
</tr>
<tr>
<td>Prize for Meritorious Service</td>
<td>• Support of damage rehabilitation and survey of suffering caused by the Great East Japan Earthquake disaster</td>
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### Domestic industrial rights in possession

<table>
<thead>
<tr>
<th>Category</th>
<th>Independently owned</th>
<th>Jointly owned</th>
<th>Subtotal</th>
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<tbody>
<tr>
<td>Patent</td>
<td>Registered</td>
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<td>496</td>
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<tr>
<td></td>
<td>Applied for (Examination applied for)</td>
<td>568 (232)</td>
<td>354 (177)</td>
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<tr>
<td></td>
<td>Subtotal</td>
<td>1231</td>
<td>850</td>
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<tr>
<td>Utility model</td>
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<td></td>
<td>Applied for</td>
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<td></td>
<td>Subtotal</td>
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<tr>
<td>Design patent</td>
<td>Registered</td>
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<td>15</td>
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<td>Applied for</td>
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<td></td>
<td>Subtotal</td>
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<td>15</td>
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<td>Trademark</td>
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<td>Applied for</td>
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<td></td>
<td>Subtotal</td>
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<tr>
<td>Total</td>
<td>Registered</td>
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<td>511</td>
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<tr>
<td></td>
<td>Applied for</td>
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<tr>
<td></td>
<td>Subtotal</td>
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(As of March 31, 2013)

### Overseas industrial rights in possession

<table>
<thead>
<tr>
<th>Status</th>
<th>Number of applications</th>
<th>Number of the countries of registration</th>
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<tr>
<td>Registered</td>
<td>26</td>
<td>71</td>
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<tr>
<td>Registered or Registered applied for</td>
<td>9</td>
<td>29</td>
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<tr>
<td>Applied for</td>
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<td>-</td>
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<td>Total</td>
<td>47</td>
<td>100</td>
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(As of March 31, 2013)
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 2, 2012</td>
<td>Reorganization of Railway Technical Research Institute (RTRI)</td>
</tr>
<tr>
<td>April 2, 2012</td>
<td>FY 2012 Initiation Ceremony</td>
</tr>
<tr>
<td>April 18, 2012</td>
<td>FY 2012 Commendation by Minister of Education, Culture, Sports Science and Technology</td>
</tr>
<tr>
<td>April 29, 2012</td>
<td>Medal with Yellow Ribbon - A research director awarded a decoration by Japanese Government</td>
</tr>
<tr>
<td>June 14, 2012</td>
<td>New executive members</td>
</tr>
<tr>
<td>July 20, 2012</td>
<td>Opening of &quot;an earthquake and structure engineering exchange meeting - preparing for a local earthquake in a metropolitan area.&quot;</td>
</tr>
<tr>
<td>August 2, 2012</td>
<td>Opening of &quot;a signalling and telecommunications technology exchange meeting&quot;</td>
</tr>
<tr>
<td>August 7, 2012</td>
<td>Opening of &quot;a human science technology exchange meeting -toward railway safety-&quot;</td>
</tr>
<tr>
<td>August 7, 2012</td>
<td>Election of chairman and undertaking of a role as secretariat of ISO/TC 269 National Mirror Committee</td>
</tr>
<tr>
<td>August 10, 2012</td>
<td>Opening of &quot;a transportation technology exchange meeting&quot;</td>
</tr>
<tr>
<td>August 30, 2012</td>
<td>Railway Technical Research Institute technology forum 2012 was held.</td>
</tr>
<tr>
<td>October 3, 2012</td>
<td>Opening of &quot;a power supply technology exchange meeting - efforts for improvement of function and performance of power supply facilities-&quot;</td>
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<tr>
<td>October 3, 2012</td>
<td>Award of a prize from the Ministry of Land, Infrastructure, Transport and Tourism for FY 2012 computerization month</td>
</tr>
<tr>
<td>October 4, 2012</td>
<td>Opening of “Japan - France railway technology symposium 2012”</td>
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<td>October 4, 2012</td>
<td>Opening of “Japan - France collaborative research seminar”</td>
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<tr>
<td>October 12, 2012</td>
<td>Opening of “a rolling stock technology exchange meeting - towards safe and comfortable rolling stock-”</td>
</tr>
<tr>
<td>October 18, 2012</td>
<td>Opening of “a training/education programme for railway structure diagnosis experts”</td>
</tr>
<tr>
<td>November 2, 2012</td>
<td>Opening of “a track technology exchange meeting - track technologies for supporting safe running of rolling stock”</td>
</tr>
<tr>
<td>November 5, 2012</td>
<td>Opening of “a railway technical discussion at RTRI”</td>
</tr>
<tr>
<td>November 9, 2012</td>
<td>Opening of “1st General Assembly of ISO/TC 269”</td>
</tr>
<tr>
<td>November 9, 2012</td>
<td>Opening of the FY 2012 lecture by Railway Technology Promotion Center</td>
</tr>
<tr>
<td>November 29, 2012</td>
<td>Opening of “a disaster prevention technology exchange meeting - technology for prevention and limitation of disaster damage by changing natural external forces-”</td>
</tr>
<tr>
<td>December 5, 2012</td>
<td>Opening of “a Railway Technical Research Institute technology forum 2012 (held in Osaka)”</td>
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<tr>
<td>December 17, 2012</td>
<td>The FY 2012 ceremony of the anniversary of the foundation</td>
</tr>
<tr>
<td>December 25, 2012</td>
<td>Opening of “a memorial lecture for the 50th anniversary of R&amp;D on superconductive maglev for high speed railways”</td>
</tr>
<tr>
<td>March 8, 2013</td>
<td>A visit to RTRI from the Minister of State for Transport from the UK</td>
</tr>
</tbody>
</table>

(FY 2012: April 1, 2012 - March 31, 2013)
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Published by Hideyuki TAKAI, Executive Director

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