"THE WAY OF DRAMATIC REDUCING LEVEL CROSSING ACCIDENTS BY MORE THAN 80% IN 30 YEARS. - FROM THE ASPECT OF INNOVATIVE TECHNOLOGIES - "

West Japan Railway Company
Yasuhiro(Hiro) Furusawa
### Overview of Railway in Japan

<table>
<thead>
<tr>
<th></th>
<th><strong>Railways in Japan</strong></th>
<th><strong>JR group</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. of operators</strong></td>
<td>Approx. 200 (JR group, private railways, light rails, monorails, etc.)</td>
<td>7 (6 passenger railways, 1 freight railway)</td>
</tr>
<tr>
<td><strong>Service km</strong></td>
<td>Approx. 28,000 km</td>
<td>Approx. 20,124 km (JR-WEST: 5,007 km)</td>
</tr>
<tr>
<td><strong>No. of employees</strong></td>
<td>Approx. 200,000 (in railway business)</td>
<td>Approx. 120,000 (JR-WEST: Approx. 25,000)</td>
</tr>
</tbody>
</table>

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**Overview of our Company**

- JR Kyushu
- JR Shikoku
- JR Central
- JR East
- JR Hokkaido
- JR Freight

(Data for the JR Group nationwide: See “Railway Statistics 2012” (MLIT Japan))

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**Osaka**

**Tokyo**
Overview of West Japan railway company

- **Establishment**: 1 April, 1987
- **Common stock**: 0.78 billion EUR*
- **Employees**: JR-West 25,821, JR-West Group 47,382
- **Businesses**:
  - Transport
  - Retail
  - Real estate
  - Other businesses
- **Subsidiaries**: 151 (incl. 63 consolidated subsidiaries)

- **Stations**: 1,200
- **Passenger cars**: 6,562
- **Total route length**: 5,008 km
- **Passenger-kilometers total (year)**: 58,271 million

Population and GDP:
- **All Japan**
  - Population: 128 million
  - GDP: 3.50 trillion EUR
- **Japan (include West Japan)**
  - Population: 128 million
  - GDP: 3.50 trillion EUR

- **Region**:
  - **Kanazawa**
    - Population: 0.5 million
  - **Hakata**
    - Population: 1.5 million
  - **Osaka**
    - Population: 20 million (5 million/day)
  - **Kobe**
    - Population: 1.2 million
  - **Kyoto**
    - Population: 0.7 million
  - **Hiroshima**
    - Population: 1.2 million
  - **Okayama**
    - Population: 0.7 million

*1 EUR = 130 JPY*
### Recent operating results

1EUR ≈ 130 JPY

<table>
<thead>
<tr>
<th>Years ended March 31</th>
<th>Operating revenues</th>
<th>Operating income</th>
<th>Recurring profit</th>
<th>Profit attributable to owners of parent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Millions of yen</td>
<td>%</td>
<td>Millions of yen</td>
<td>%</td>
</tr>
<tr>
<td>2018</td>
<td>1,500,445</td>
<td>4.1</td>
<td>191,365</td>
<td>8.5</td>
</tr>
<tr>
<td>2017</td>
<td>1,441,411</td>
<td>(0.7)</td>
<td>176,392</td>
<td>(2.8)</td>
</tr>
</tbody>
</table>

(Left) Comprehensive Income: Year ended March 31, 2018: ¥114,171 million, 24.0%; Year ended March 31, 2017: ¥92,097 million, (12.1%)

<table>
<thead>
<tr>
<th></th>
<th>Profit attributable to owners of parent per share</th>
<th>Profit attributable to owners of parent per share after dilution</th>
<th>Return on equity</th>
<th>Recurring profit-to-total assets ratio</th>
<th>Operating income-to-operating revenues ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yen</td>
<td>Yen</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>2018</td>
<td>570.72</td>
<td>—</td>
<td>11.3</td>
<td>5.8</td>
<td>12.8</td>
</tr>
<tr>
<td>2017</td>
<td>471.52</td>
<td>—</td>
<td>10.0</td>
<td>5.5</td>
<td>12.2</td>
</tr>
</tbody>
</table>

(Reference) Gain on investment by equity method: Year ended March 31, 2018: ¥2,480 million; Year ended March 31, 2017: ¥1,574 million
Since the establishment of our company (West Japan Railway Company) in 1987, the number of occurrences of level crossing accidents had been successfully reduced by more than 80% in 30 years.

144 cases on 1987 ⇒ 24 accidents on 2017 ▲ 120 accidents
Fundamental measures against level crossing accidents

Total number of LC

<table>
<thead>
<tr>
<th>Year</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC</td>
<td>5936</td>
<td>5927</td>
<td>5915</td>
</tr>
<tr>
<td>of which passive LC</td>
<td>498 ▲19 ⇀ 479 ▲11 ⇀ 468</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of which active LC</td>
<td>5438 +10 ⇀ 5448 ▲1 ⇀ 5447</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Passive LC → Active LC

The installation of warning system and protection
In addition to fundamental countermeasures, we have reduced the number of Level crossing accidents by the four latest methods we will introduce.

Further improving (to devices)
- 3-dimensional laser radar type obstacle detection device
- Special signal light emitting devices improved with the aim of train driver’s awareness by "voice" using radio

Reducing (of warning time)
- Clever level crossing
- Countermeasure against level crossing for a long time at train deterrence
In addition to fundamental countermeasures, we have reduced the number of Level crossing accidents by the four latest methods we will introduce.

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- Countermeasure against level crossing for a long time at train deterrence
3-dimensional laser radar type obstacle detection device

Laser light is irradiated from the laser head, and obstacles on the level crossing road are monitored.
Introduction Record of 3 dimensional obstacle detector in the world

- **East Japan Railway**: 865 units
- **West Japan Railway**: 499 units
- **Other Railways in Japan**: 278 units
- **SNCF**: 2 units
- **RFI**: 130 units

※As of March 2017
In addition to fundamental countermeasures, we have reduced the number of Level crossing accidents by the four latest methods we will introduce.

**Further improving (to devices)**
- 3-dimensional laser radar type obstacle detection device
- Special signal light emitting devices improved with the aim of train driver’s awareness by "voice" using radio

**Reducing (of warning time)**
- Clever level crossing
- Countermeasure against level crossing for a long time at train deterrence
Special signal light emitting devices improved with the aim of train driver’s awareness by "voice" using radio

- No voice 1 second
- Voice "Attention forward" 1 second
- Radius approx. 1km
- Driver’s cabin Voice "Attention forward"

Special signal light emitting device
In addition to fundamental countermeasures, we have reduced the number of Level crossing accidents by the four latest methods we will introduce.

**Further improving (to devices)**
- 3-dimensional laser radar type obstacle detection device
- Special signal light emitting devices improved with the aim of train driver’s awareness by "voice" using radio

**Reducing (of warning time)**
- Clever level crossing
- Countermeasure against level crossing for a long time at train deterrence
In case of train stopping, we reduced the level crossing warning time by about 30 seconds or more.
In addition to fundamental countermeasures, we have reduced the number of Level crossing accidents by the four latest methods we will introduce.

**Further improving (to devices)**
- 3-dimensional laser radar type obstacle detection device
- Special signal light emitting devices improved with the aim of train driver’s awareness by "voice" using radio

**Reducing (of warning time)**
- Clever level crossing
- Countermeasure against level crossing for a long time at train deterrence
Countermeasure against level crossing for a long time at train deterrence

Troubles occurred (Human injury, vehicle failures, etc.)

Many trains deterred (stopped) at stations

warning at the level crossing near the station
Countermeasure against level crossing for a long time at train deterrence

Social impact
- Traffic congestion
- Impact on emergency vehicles and buses

Safety impact
- Reckless crossing of LC passers
- Barrier breakage due to break through level crossing

Impact on employees
- Implementation of LC monitoring
- Implementation of traffic induction

17/08/2009  Train deterrence due to vehicle failure

Total train deterrent time  9 h 49 m

In the meantime, 237 cases of reckless crossing occurred

Stop warning at level crossing by interlocking installation

Reduce risk of injury
Countermeasure against level crossing for a long time at train deterrence

**No interlocking**

Warning level crossing regardless of the signal.

**Interlocking installation**

Do not warn when the departure signal is stopped

Stop signal brake pattern

Control from the control center

Installation of interlocking at **12 stations** and improvement of **39 LC**
## Countermeasure against level crossing for a long time at train deterrence

### Effect of Countermeasure

#### Transitions in the number of level crossings

<table>
<thead>
<tr>
<th></th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Warning does not continue</td>
<td>17</td>
<td>58</td>
</tr>
<tr>
<td>Warning continues</td>
<td>43</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Avoidance of level crossing warning after countermeasure

<table>
<thead>
<tr>
<th>Date of occurrence</th>
<th>Amount of trains deterred</th>
<th>Time when trains was stopped at the station</th>
<th>Amount of LC that avoided warning</th>
<th>Total time that avoided warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>27/02/2015</td>
<td>7</td>
<td>Min 16 m</td>
<td>28</td>
<td>609 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max 27 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total 153 m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Comparison of similar accidents before and after countermeasure

<table>
<thead>
<tr>
<th></th>
<th>Accident date</th>
<th>Train deterrence time</th>
<th>Amount of times LC has continued warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>26/06/2014</td>
<td>51 m</td>
<td>37</td>
</tr>
<tr>
<td>After</td>
<td>13/01/2015</td>
<td>64 m</td>
<td>3 ※</td>
</tr>
</tbody>
</table>

※Due to the train interval became short after restarting
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Thank you for your attention