Efforts in the Focus Fields (Automated Driving)

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Mobility Systems Business Group
1. Goal
Future vision of mobility

Integration of IT and mobility

Connectivity
- Prediction of parts failure
- Lookahead of the road environment
- Remote updating
- Social security (urban watch-over service)
- Cyber mobility center (infrastructure to offer various mobility services)

Autonomous
- Determination of driver status
- Valet parking (automated)

MaaS
- Mobility system for senior citizens and children
- Car sharing/ride sharing

Sharing
- Operation management
- Supply chain coordination

Multimodal mobility

Integrate car electronics technology with IT to solve social issues
DENSO’s vision of automated driving by 2025

Achieve automated driving by using connecting and sensing technologies to serve as the core of new mobility.
2. Efforts to achieve the target
   • Automated driving
   • Cockpit system
Realization capability (individual capability × core technology)

Core technology

Sensing
- Perception beyond human visibility

Prediction
- As early and correctly as possible

Interactivity
- Communication between driver and vehicle

Connectivity
- Communication between vehicles and society

Protected
- Systems

DENSO’s strengths

- Various elemental technologies
- Quality, Reliability
- Capability to meet customers’ needs

Enhance cooperation with partners

- J-QuAD DYNAMICS
- TRI-AD
- Uber

Achieve automated driving systems by high-quality and highly-reliable engineering capabilities
## Efforts to achieve automated driving systems

<table>
<thead>
<tr>
<th>Active safety</th>
<th>ADAS/AD Lv.2/3</th>
<th>AD in limited areas Lv.4</th>
<th>Automated parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffusion period From 2017</td>
<td>Lv. 2/3 on limited highways Diffusion period From 2020</td>
<td>Lv. 2/3 on general roads Diffusion period From the first half of 2020s</td>
<td>Fully automated valet parking Diffusion period From 2020</td>
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<tr>
<td>Autonomous emergency braking</td>
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<tr>
<td>Adaptive cruise control</td>
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<td>Automatic high-beam headlights</td>
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<td>Lane departure prevention support</td>
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<tr>
<td>Traffic-sign recognition</td>
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</tbody>
</table>

### Passenger cars
- Diffusion period From 2017
- Lv. 2/3 on limited highways
- Lv. 2/3 on general roads
- From the first half of 2020s

### Commercial vehicles (trucks)
- Diffusion period From 2020
- Lv. 2/3 on limited highways
- From 2020
- Fully automated valet parking

### Shared & services (taxis/small buses)
- Introduction period From 2018
- Diffusion period From 2020s

- Lv. 2 to 4 on limited general roads
- Lv. 4 in limited areas
- From 2020s
- From the mid-2020s
Establishment of an advanced development center in Tokyo
— Taking on challenges to create new value —

Value: Realize a safe society free from traffic accidents and achieve comfortable and flexible mobility

Step 1
Planning, development, and demonstration of advanced technologies and advanced mobility systems will be accelerated through collaboration with customers and partners to release advanced mobility systems early in the market.

April 2018
Global R&D Tokyo opened

Step 2
- Develop test vehicles and conduct field tests on public roads in the Tokyo area
- Cooperate with various companies (e.g., manufacturers) in Ota-ku

June 2020
A test vehicle development building and office (with a test course) will be opened in zone No. 1 of unused land at Haneda Airport.

Implement the entire process from planning and R&D to prototype production and field tests in the Tokyo area
### Profile of Global R&D Tokyo

<table>
<thead>
<tr>
<th>Opening</th>
<th>April 2018</th>
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<tbody>
<tr>
<td>Location</td>
<td>16F and 17F, W Building, 1-8-15 Konan, Minato-ku, Tokyo</td>
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<tr>
<td>Employees</td>
<td>270 (as of December 2018)</td>
</tr>
<tr>
<td>Functions</td>
<td>R&amp;D on advanced driver assistance, automated driving, and connected vehicles</td>
</tr>
</tbody>
</table>
Profile of the test vehicle maintenance building and office in Haneda

<table>
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<tr>
<th>Opening</th>
<th>June 2020 (planned)</th>
</tr>
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<tr>
<td>Location</td>
<td>Part of Hanedakuko 1-chome and 2-chome in Ota-ku, Tokyo</td>
</tr>
<tr>
<td>Employees</td>
<td>About 200 (planned for opening)</td>
</tr>
<tr>
<td>Functions</td>
<td>Prototype development of automated driving technologies, field tests using vehicles</td>
</tr>
</tbody>
</table>
Advanced development of ADAS/AD

Development of AD system packages
- AD center

Development of automated parking systems

AD sensor kit
Advanced development of ADAS/AD: Planning and development of system packages

• Development of sensors
• Development of recognition and judgment algorithms
• Development of AI

Accelerate the realization of Lv. 4 for shared & services by using advanced sensors and centralized control
### Roadmap for the cockpit system

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2023</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social developments</strong></td>
<td><img src="image" alt="Driver assistance" /></td>
<td><img src="image" alt="Partial automated driving" /></td>
<td><img src="image" alt="Cooperative driving by the vehicle and the driver" /></td>
<td><img src="image" alt="Conditional automated driving" /></td>
<td><img src="image" alt="Advanced automated driving" /></td>
<td><img src="image" alt="Driving mainly by the vehicle" /></td>
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</tr>
<tr>
<td><strong>Advance- ment of the cockpit</strong></td>
<td><img src="image" alt="DENSO UX 1.0" /></td>
<td><img src="image" alt="Assist the driver" /></td>
<td><img src="image" alt="E-cockpit" /></td>
<td><img src="image" alt="Cockpit integration control" /></td>
<td><img src="image" alt="DENSO UX 2.0" /></td>
<td><img src="image" alt="Adapt to the driver" /></td>
<td><img src="image" alt="Intelligent-cockpit" /></td>
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<tr>
<td><img src="image" alt="4G" /></td>
<td><img src="image" alt="Driving information" /></td>
<td><img src="image" alt="5G" /></td>
<td><img src="image" alt="Outside-car traffic information" /></td>
<td><img src="image" alt="DENSO UX 2.0" /></td>
<td><img src="image" alt="6G" /></td>
<td><img src="image" alt="Social information" /></td>
<td></td>
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</table>

- **E-cockpit**
  - Cockpit integration control

- **Intelligent-cockpit**
  - In-vehicle AI technology

- **i-cabin**
  - Cabin integration control

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**Offer cockpit systems that support the driver in line with the advancement of vehicles**
Coordination between air-conditioning technology and HMI technology (thermal collaboration) — Challenges to create new value —

Example of i-cabin development

Cockpit appropriate for the new era
- Wide field of view, large foot space, and a thin instrument panel
- Incorporation of an advanced display device

A space that offers peace of mind appropriate for automated driving
- Driver status (drowsiness, carelessness) determination and awakening systems

Air flow that can be controlled flexibly
- Air flow based on the occupants’ positions
- Capable of controlling the air quality at will

Integration of DENSO’s air-conditioning technology and HMI technology
3. Growth target
Mobility Systems Business – Revenue target for FY2026

Aim to achieve 1.1 trillion yen by FY2026 by contributing to the spread of automated driving (about 1.4 times compared to the results in FY2019)
Aiming to realize “Quality of Mobility” by achieving a three-way harmony between people, vehicles, and society as a whole, to bring the joy of mobility to all people.