Railway, Automotive & Machinery Parts
Business Strategy

– Accelerating Distinctiveness –
Sales target for FY 2006: Consolidated total sales of 100 billion yen

- **Railway products 40 %**
  - Crankshafts
  - Front axles
  - Aluminum wheels
  - Retarders
  - VC rolls
  - High-pressure vessels
  - Dies & molds
  - Ring products

- **Automobile and construction machine products 45 %**
  - Domestic 35 %
  - U.S. and China 10 %
  - Wheels
  - Axles
  - Brake disks
  - Bogie trucks
  - Couplers

- **Industrial equipment and mechanical parts 15 %**
Railway Products - Part 1

Bogie trucks

Couplers
Railway Products - Part 2

- Bogie trucks
- Wheels
- Axles
- Gear units
- Driven wheelsets
- Forged steel brake disks
Automobile and Construction Machine Products

- Engines for automobiles (cross section)
- Front axles for trucks
- Small-size crankshafts for passenger cars
- Large-size crankshafts for trucks and buses
### Domestic Market Share of Products

(Based on our estimation)

<table>
<thead>
<tr>
<th>Products</th>
<th>Market share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheels</td>
<td>100 %</td>
</tr>
<tr>
<td>Axles</td>
<td>100 %</td>
</tr>
<tr>
<td>Forged steel brake disks</td>
<td>100 %</td>
</tr>
<tr>
<td>Gear units</td>
<td>60 %</td>
</tr>
<tr>
<td>Couplers</td>
<td>80 %</td>
</tr>
<tr>
<td>Bogie trucks</td>
<td>25 %</td>
</tr>
<tr>
<td>Small-size crankshafts for passenger cars</td>
<td>20 %</td>
</tr>
<tr>
<td>Large-size crankshafts for trucks and buses</td>
<td>75 %</td>
</tr>
</tbody>
</table>

Over 80 % of our whole sales have top shares of the respective markets
Growth of Sales Amount and Medium-Term Business Plan ( Consolidated )

Industrial equipment and mechanical parts
Automotive products
Railway products

Sales (JPY billion)

<table>
<thead>
<tr>
<th>Year</th>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06 (Target)</th>
<th>08 (Plan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>64</td>
<td>66.4</td>
<td>67.5</td>
<td>77.9</td>
<td>95</td>
<td>100</td>
<td>110</td>
</tr>
</tbody>
</table>
Strategies of Railway Product Business

- New technologies to domestic markets
- Approach to overseas markets
Domestic: Increase of the Value Added by Offering Technologies for Higher Speed and Functionality

- **Local line**
  - High functionality
    - Noise damped wheels
    - Light-weight corrugated wheels
  - High speed
    - Tilting (control) system

- **Shinkansen**
  - High functionality
    - Low-noise gears
  - High speed
    - Active suspension system

**Target**
Highly Functional Products for Local Lines

**Light-weight corrugated wheels**

![FEM image](image)

Weight saved by 7%

- 341kg/p
- 317kg/p

**Noise damped wheels**

- Regular wheel: 113dB
- Round sectioned ring type: 101dB
- Sandwiched ring type: 92dB

Effect of noise reduction by 10 to 20 dB
Technology for Higher Speed for Local Lines

Pneumatic spring tilting system

Meitetsu Airport Limited Express

- Max 2 degrees of tilting angle
- Exhaust for lowering
- Intake for lifting
- Speeding up on the curved track: max. +15km/h

Customer’s top priority: traveling from Nagoya station to the Airport “within 30 min.!”

- Achievement of 28 min. by our new technologies
Development of low-noise gears by our unique load tester

- World’s only gear unit load tester in the anechoic room
- Max turning speed: 10,000rpm (equivalent to 500km/h)

- Effect of noise reduction with newly developed gear tooth profile (patent pending)
Technology for Higher Speed for Shinkansen

Active suspension system: World’s first success in practical use

Hayate of JR East

Vehicle body

Cancel

Actuator

Oscillation

Wheelset

Without

Lateral oscillation

With

Lateral oscillation

Railway Products

SUMITOMO METALS
Overseas - Part 1: Trend in Demand for Wheels in U.S.

### Background of increase of demands
- Recurrence to railways for energy saving
- Increase of distribution of import goods from China (West Coast to East)
- Severer replacement standard → Shorter service life of wheel

<table>
<thead>
<tr>
<th>Year</th>
<th>Demand (thousand pieces)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>1,000</td>
</tr>
<tr>
<td>02</td>
<td>1,100</td>
</tr>
<tr>
<td>03</td>
<td>1,200</td>
</tr>
<tr>
<td>04</td>
<td>1,300</td>
</tr>
<tr>
<td>05</td>
<td>1,400</td>
</tr>
<tr>
<td>06</td>
<td>1,500</td>
</tr>
<tr>
<td>07</td>
<td>1,600</td>
</tr>
<tr>
<td>08</td>
<td>1,700</td>
</tr>
</tbody>
</table>

(Forecast)
Increase of our production capacity to meet the robust demands for wheels in U.S.
• Delivery of the parts to be installed in Shinkansen-type vehicles such as wheels, axles, gear units and couplers
• Taiwan Shinkansen: Completion of the delivery of parts for new vehicles
• High-speed railway network in China: Plan to manufacture five thousand new vehicles in three years.
  (Number of Shinikansen vehicles in service in Japan: approx. four thousand vehicles)
### Production Volume of Each Forged Steel Wheel Manufacturer in the World (Based on our estimation for FY05)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Production Volume (thousand pieces)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vyksa (Russia)</td>
<td></td>
</tr>
<tr>
<td>N (Ukraine)</td>
<td></td>
</tr>
<tr>
<td>NT (Russia)</td>
<td></td>
</tr>
<tr>
<td>Maanshan (China)</td>
<td></td>
</tr>
<tr>
<td>S.S (US)</td>
<td></td>
</tr>
<tr>
<td>Sumitomo Metals</td>
<td></td>
</tr>
<tr>
<td>Bona. (Czech)</td>
<td></td>
</tr>
<tr>
<td>BVV (Germany)</td>
<td></td>
</tr>
<tr>
<td>Lucchini (Italy)</td>
<td></td>
</tr>
<tr>
<td>Tai Yuan (China)</td>
<td></td>
</tr>
<tr>
<td>Valdunes (France)</td>
<td></td>
</tr>
<tr>
<td>DSP (India)</td>
<td></td>
</tr>
<tr>
<td>Smorgon (Australia)</td>
<td></td>
</tr>
<tr>
<td>MWL (Brazil)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>

**Global total:** approx. 3 million pieces

**Other cast steel wheels:** approx. 1.3 million pieces

**Top production volume among wheel manufacturers for high-speed vehicles:**

- **Sumitomo Metals:** 200 (FY2006 target)
- **Including wheels for high-speed trains**
- **Only for local lines**

*Top quality and highest volume in the world*
1. **Expansion of domestic railway business**
   - Promotion of the technologies for higher speed and functionality to increase the value added.

2. **Approach to overseas markets**
   - Increase of our production capacity to expand the sales of wheels for U.S. market.
   - Participation in the projects in Taiwan and China.

3. **Implementation of the above-mentioned initiatives to increase the sales by 15% from FY 2005 to FY 2008.**
Strategies of Automobile and Construction Machine Product Business

[Trend]

1. Worldwide expansion of automobile production volume
2. Increase in use of forged steel crankshafts
3. Increase of V type-engines
Worldwide automobile production volume: Increase by approx. 17% (from 2005 to 2015)

Automobile production volume by each region

The numerical values indicate the indices based on the year 2005 as 100.
## Comparison Between Forged Steel Crankshaft and Cast Iron Crankshaft

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cast iron</th>
<th>Forged steel</th>
<th>Impact factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength</td>
<td>○</td>
<td>◐</td>
<td>Reliability and fuel economy</td>
</tr>
<tr>
<td>Rigidity</td>
<td>△</td>
<td>◐</td>
<td>Low oscillation and low noise</td>
</tr>
<tr>
<td>Machinability</td>
<td>○</td>
<td>△→○</td>
<td>Machining costs</td>
</tr>
<tr>
<td>Manufacturing costs</td>
<td>○</td>
<td>△→○</td>
<td>Costs</td>
</tr>
</tbody>
</table>
Share of Forged Steel Crankshaft for Automobiles

(Based on our estimation)

- Smaller, more powerful engine with higher fuel economy ⇒ Expansion of use of forged steel crankshafts
- Increase in use of forged steel crankshafts in North America from 40% in 2005 to 60% in 2015

Use of forged steel crankshafts for automobiles

- Japan
- U.S.
- Europe
Mass-Production of V-Type Forged Steel Crankshaft

Conventional six-cylinder engine

V-type six-cylinder engine

Conventional crankshaft  (For 3-liter passenger cars)

V-type crankshaft

Total length: - 30 %

Weight: - 1/3  
33kg/p → 22kg/p

Gnarled shape - advanced forging technologies are required.

Needs of automobile manufacturers

Demand for development of V-type forged steel crankshafts for smaller, more powerful engines

Our technologies achieved the world’s first success in developing forging technology.

World’s first success in mass-production
(Award for Excellence in Formings granted by the Minister of International Trade and Industry)
## Overseas Crankshaft Business and Production Capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>Facility construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>ICI (US) First term 6,000-ton die forging press line installed</td>
</tr>
<tr>
<td>1997</td>
<td>ICI (US) Second term 7,000-ton die forging press line installed</td>
</tr>
<tr>
<td>2004</td>
<td>Huizhou Sumikin (China) First term 6,000-ton die forging press line installed</td>
</tr>
<tr>
<td>(2008)</td>
<td>Huizhou Sumikin (China) Second term (Under construction)</td>
</tr>
<tr>
<td>(2009)</td>
<td>ICI (US) Third term (Under construction)</td>
</tr>
<tr>
<td>------</td>
<td>ASEAN (Undecided) First term</td>
</tr>
</tbody>
</table>

### Sumitomo’s production capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>Japan</th>
<th>U.S.</th>
<th>China</th>
<th>ASEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>2.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>3.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>4.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>(100)</td>
<td>7.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td>(116)</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td>(159)</td>
</tr>
</tbody>
</table>

- **Production capacity (million pieces)**
- **Japan**: +1.2
- **U.S.**: +0.3
- **China**: +1.2
- **ASEAN**: +1.2
Installation of “Twisters” to meet increase in sales volume of V-type forged steel crankshafts by luxury-oriented trends

![Our sales performance chart](chart.png)

Sales Volume of V-Type Forged Steel Crankshafts

- Sales Volume of V-Type Forged Steel Crankshafts
Aim Over 10 % World Share

- Expansion in the world market
- Leading to growth in Japanese automobile manufacturers’ production
- Resulting in an increase in Sumitomo’s crankshaft business through our resource

**Achievement of Global 10**

**Europe**
- Approx. 21 million vehicles

**China**
- Approx. 10 million vehicles

**Asia**
- Approx. 10 million vehicles

**Japan**
- Approx. 11 million vehicles
- Osaka
  - 2005: 3.4 million pieces
  - 2008: 4 million pieces
  - 2015: 4 million pieces

**Huizhou Sumikin**
- 2005: 0.3 million pieces
- 2008: 1.8 million pieces
- 2015: 2.1 million pieces

**New facility**
- 2005: 0 million pieces
- 2015: 1.2 million pieces

**North America**
- Approx. 19 million vehicles

**ICI**
- 2005: 1.3 million pieces
- 2008: 1.5 million pieces
- 2015: 2.7 million pieces

**South America**
- Approx. 5 million vehicles

<table>
<thead>
<tr>
<th>Year</th>
<th>Worldwide automobile production</th>
<th>Japanese manufacturers</th>
<th>Sumitomo’s production</th>
<th>Sumitomo’s share</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>65 million vehicles</td>
<td>22 million vehicles</td>
<td>5 million crankshafts</td>
<td>8%</td>
</tr>
<tr>
<td>2008</td>
<td>69 million vehicles</td>
<td>25 million vehicles</td>
<td>7.3 million crankshafts</td>
<td>11%</td>
</tr>
<tr>
<td>2015</td>
<td>76 million vehicles</td>
<td>31 million vehicles</td>
<td>10 million crankshafts</td>
<td>13%</td>
</tr>
</tbody>
</table>
Production Volume of Forged Steel Crankshafts
(Based on our estimation for FY 2005)

Global total of 38.4 million pieces

Annual Production Volume (million pieces)

- Thyssen Krupp
- Sumitomo Metals: 5.0
- Aichi Steel
- KAKUTA IRON WORKS
- TFO
- Bharat Forge (India)
- Forja de Monterry (Mexico)
- Automobile manufactures’ inhouse manufacturing
- Others
Crankshaft Business Strategy

Business climate

1. The automobile production will grow in China and U.S.
2. The forged steel crankshafts will be increasingly used.
3. The trends in crankshafts will shift to the V-type crankshafts that require advanced forming technologies.

Business strategy

1. Active approach to the markets in North America and China
2. Focus on high-grade crankshafts and acceleration of distinctiveness at each facility around the world
3. Increase of our sales by 17% from FY 2005 to FY 2008
Source of Strengths and Business Strategies of Railway, Automotive & Machinery Parts Company
Cycle of Manufacturing

Engineering design → Manufacturing

Evaluation/ improvement ← In service
Cycle of Manufacturing by Ordinary Manufacturer

- **Engineering design**
- **Evaluation/ improvement**
- **Manufacturing**
  - Drawing Specifications
  - No more than drawing-based manufacturing
- **In service**
- **Delivery**
- **User**
- **Manufacturer**
Cycle of Value Added Manufacturing by Railway, Automotive & Machinery Parts Company

Capability of rotating the whole cycle by ourselves

- **Engineering design**
  - Analytical technology such as FEM

- **Manufacturing**
  - World’s highest technologies for manufacturing

- **Evaluation/improvement**
  - Utilization of various testers to reproduce the service conditions

- **In service**
  - Monitoring the service conditions jointly with customers

- **Delivery**

Customers’ needs
1. Our development of stress analysis techniques for designing the Shinkansen parts was an origin of our milestone.

2. Subsequent further advanced developments have been applied to various analyses such as steel solidification, heat-treatment transformation and residual stress.

Example of application to heat-treatment analysis on crankshaft

- Development of our proprietary software for hardening analysis
- Proposal of optimum shape and adoption for mass-production
- Max stress reduced by 35%
World’s Highest Strength in Manufacturing

Source of our strengths in manufacturing

1. All-round production from steel making, forging, heat-treatment, finishing and further to dies/molds to be used

   Meet various needs from customers and achieve the shortest delivery time

2. Application of Converter-CC materials

   Higher yield and cleanliness

3. Development of ingenious forging facilities

   Higher yield and productivity
Ingenious Forging Facilities

SIRD press for forming the wheels
(World’s only facility)

Principle of SIRD

Rotary forging
- Excellent forging capacity with a smaller force
- Closed die forging

Yield increase by 7%

5,000-ton full automatic high-speed crankshaft forging line

Production efficiency: 450 P/H
Man-power: 2 operators (only for monitoring and die-change)
Evaluation / Improvement: Testing Facilities

High-speed bogie testing stand

Fatigue tester for the actual size wheels

Brake tester for Shinkansen

Engine tester

Engineering design
Analytical technology such as FEM
Evaluation/improvement
Utilization of various testers to reproduce the service conditions
In Service
Monitoring the service conditions jointly with customers

World’s highest technologies for manufacturing
Prototype Evaluation Cycle in Development of New Products

- **Engineering design**
  - Analytical technology such as FEM

- **Manufacturing**
  - World’s highest technologies for manufacturing

- **Evaluation/improvement**
  - Utilization of various testers to reproduce the service conditions

**Capability of rotating the development cycle by ourselves**
Steering Bogie Truck

Traveling on straight track

Direction of travel

Direction of track

Direction of wheel travel

Link mechanism

Traveling on curved track

Direction of travel

Regular bogie truck

Difference in direction between the track and the wheel travel

Steering bogie truck

Same direction between the track and the wheel travel

- Resistance to derailment
- Lower noise
- Lower wheel abrasion

• Resistance to derailment
• Lower noise
• Lower wheel abrasion
Large-Scale Testing Facility: Small Radius Test Track

- Construction of the small radius test track in our shop
- Three rail track for testing on both narrow and standard gages
- Effective tool for developing the special bogie for a snaked line

A truck for trailing
Test bogie truck
Curved track

Total length:
Approx. 200m
Deliver sustained growth in corporate value by emphasizing quality

Become a company trusted by all stakeholders