The Japanese Steel Industry In The Global Steel Market

The Japan Iron and Steel Federation
Overview

- Dramatic growth in steel consumption in emerging markets since the Asian financial crisis.
  - Emerging markets now drive global steel consumption and consumption growth
- Major consolidation of steelmaking assets in the Americas, Europe and Japan.
  - U.S. industry now centered around three large producers: U.S. Steel, Arcelor-Mittal, and Nucor
  - European industry now centered around two large producers: ArcelorMittal and Tata/Corus
  - Japanese industry now centered around two large producers: Nippon Steel and JFE
- Emergence of global steel producers
  - ArcelorMittal largest global producer (98 million tons produced in 2010) with steelmaking capacity located on four continents.
  - Numerous steel producers now invested in steelmaking outside home country through greenfield investments, acquisitions, and joint-ventures
(1) Global Economy and Steel Consumption

- Asian financial crisis … page 3-4
- Macro economic changes … page 5-6
- Steel consumption changes… page 7-8
Dramatic Macroeconomic Changes . . .

- U.S. trade cases were filed during height of Asian Financial Crisis, 1998-1999, which witnessed a dramatic drop in GDP among Asian countries
  - Thailand: -10.5% in 1998
  - Indonesia: -13.1% in 1998
  - Malaysia: -7.4% in 1998
  - Korea: -6.9%

- In contrast, the U.S. was in a period of solid growth with GDP growing 4.4% in 1998 and 4.9% in 1999
Between 1996 and 1998 U.S. consumption of finished steel *increased* by 12.5 million metric tons.

In contrast, between 1997 and 1998 consumption of finished steel in Asia *declined* by nearly 30 million tons.

- Decline is 38 million tons when China is excluded
- The combination led to unprecedented volumes of Japanese shipments to U.S. of commercial grade products
Today’s Conditions Could Not Be More Different . . .

- Average annual GDP growth for U.S. from 2000-2010 was 2.3%

- Average annual GDP growth for Asian countries
  - China -- 10.3%
  - Indonesia -- 5.2%
  - Malaysia -- 5.0%
  - Thailand -- 4.4%
  - South Korea -- 4.5%
Affecting Steel Consumption

- Between 1999 and 2010 annual consumption of finished steel in the United States decreased by 42 million metric tons.

- Between 1999 and 2010 annual consumption of finished steel in Asia increased by 501 million metric tons.

- Or stated differently, 96 percent of the world’s total growth in annual steel consumption since 1999 has been in Asia.
  - Asia is where the biggest steel customers are.
Global Consumption

Source: World Steel Association Steel Statistical Yearbook
Geographical Changes in Steel Consumption

Source: World Steel Association Steel Statistical Yearbook
(2) Japanese Industry Evolved To Adapt To Changing Environment

- Consolidation and rationalization
  - NKK and Kawasaki merge in September 2002
  - Nippon Steel and Sumitomo Metal Industries projected to complete merger by October 2012, to result in further capacity rationalization

- Global steel making investments ... pp. 10-13

- Refocused regional emphasis ... pp. 14
  - Emerging markets in Asia

- Refocused product mix ... pp. 15-33
  - Leverage R&D to push into higher value-added, specialized products
Emphasis on Long-Term Sustainability of Operations

- Japanese industry has adapted to inherent raw material cost disadvantages through a philosophy centered on long-term investment (Global alliances, FDI, capex, R&D, and service) at the expense of higher short-run profits.

- By contrast, a reconstituted and restructured U.S. industry has sought to maximize basic upstream cost advantages and shorter run profits.
  - As documented by the U.S. International Trade Commission (ITC), Between 2005 and 2010, the core operations of the U.S. flat-rolled steel industry, using hot-rolled steel production as a proxy, generated over $4.8 billion in cash even after deducting allowances for depreciation and amortization, as well as capital expenditures.
  - Also documented by the ITC, in 2005 and pro-rated 2006, the downstream U.S. corrosion resistant flat-rolled segment reported positive cash flow approaching $1 billion.
  - Sizeable cash generation has not narrowed the gap in key sustainability metrics, such as FDI, R&D and capex vis-à-vis global competitors.

- Competing philosophies result in very different competitive dynamics in the market.
Commitment to Global Investments

- Japanese exports follow global investments
- Major investments made in growing regional markets
- Japanese mills have established numerous strategic production joint ventures in fast growing Asian markets, such as Thailand, Indonesia, China and Malaysia
- These joint ventures capitalize on two key facts: (a) rapidly increasing consumption of steel products, and (b) lack of a local producer or insufficient local capacity to meet demand.
- Most joint ventures require sourcing of substrate from Japanese mills
  - Such investments and sourcing requirements keeps Japanese mills focused on Asia
- Outside of ArcelorMittal, which is a global entity, the U.S. industry is not a major source of production-related FDI
Global Footprint: Nippon Steel Affiliates and Alliance Partners

- **Nippon Steel**
- **Arcelor Mittal**
- **Suzuki Garphyttan** (Automotive valve spring wires)
- **Global Network**
  - **Sweden**
  - **China**
    - BIRA (Automotive steel sheets)
    - HGS China (Automotive bars and wire rods)
    - FATIII (Steel can stamping)
    - Wari HSP (Automotive pipes and tubes)
    - WNS (Steel can stamping)
  - **South Korea**
    - POSCO (MSC Equity ratio 5%)
  - **India**
    - Joint venture with Tata Steel (Automotive steel sheets)
    - Nippon Pipe India (Automotive steel pipes)
  - **Thailand**
    - SUS (Automotive steel sheets)
    - SNP (Automotive pipes and tubes)
    - TIP (Steel can stamping)
    - NEC Thailand (Automotive bars and wire rods)
    - Nippon Steel Galvanizing Thailand (Automotive steel sheets)
  - **Vietnam**
    - POSCO Vietnam (Cold-rolled sheets)
    - PEB STEEL (Construction sheets)
    - NP (Steel pipe piles/Steel pipe sheet piles)
  - **Indonesia**
    - IRP (Automotive pipes and tubes)
    - LATINUSA (Steel can stamping)
  - **Malaysia**
    - Nippon SGV Steel (Electrogalvanized sheets)
    - WGI Hot-dip galvanized/Colored steel sheets
  - **Nigeria**
    - Midland Rolling Mills (Cold-rolled steel sheets)
  - **South Africa**
    - Safal Steel (Coated/colored sheets)
  - **U.S.A.**
    - LN Tek (Automotive steel sheets)
    - LN Kite (Automotive steel sheets)
    - Suzuki Garphyttan (Automotive valve spring wires)
  - **Mexico**
    - TENIGAL (Automotive steel sheets)
  - **Brazil**
    - USIMINAS (MSC: Equity ratio 27.5%, equity method affiliate)
    - UNIGAL (Automotive steel sheets)
Global Footprint: JFE Production / Sales Partners

**China**
- Guangzhou JFE Sheet
- Hainan Haiwoo Tinplate
- Fujian Sino-Japan Metal
- Bohai NKK Drill Pipe
- Pancheng Yihong Pipe

**South Korea**
- Dongkuk Steel
- Hyundai HYSCO
- Dongbu Steel

**Canada**
- DJ Galvanizing

**U.S.A.**
- California Steel
- AK Steel

**Germany**
- ThyssenKrupp
- Georgsmarienhuette (GMH)

**Greece**
- Corinth Pipeworks

**Pakistan**
- International Steel

**India**
- JSW Steel

**Thailand**
- JFE Steel Galvanizing
- Thai Coated Steel Sheet (TCR)
- Thai Cold Rolled Steel Sheet (TCS)
- Thai Tinplate Manufacturing

**Taiwan**
- Ton-yi

**Indonesia**
- Sermani Steel
- Germani Steel

**Malaysia/Vietnam**
- Perstima, Mycron
- Sun Steel Joint Stock Co.
- J-Spiral Steel Pipe

**Germany**
- ThyssenKrupp
- Georgsmarienhuette (GMH)

**JFE Steel (Japan)**

**Japan**
- JFE Steel

**Colombia**
- Hojalata Y Laminados
Japanese Exports Reflect Changes in Geographic Consumption

### Japan's Total Iron and Steel Export by Country/Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
<th>Amount (1000 tons)</th>
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<tbody>
<tr>
<td>Asia</td>
<td>73.5%</td>
<td>20,729</td>
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<tr>
<td>U.S.A</td>
<td>9.9%</td>
<td>2,803</td>
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<tr>
<td>Middle East</td>
<td>4.5%</td>
<td>1,283</td>
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<tr>
<td>Europe</td>
<td>3.6%</td>
<td>1,004</td>
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<tr>
<td>Oceania</td>
<td>1.9%</td>
<td>544</td>
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<tr>
<td>Africa</td>
<td>1.2%</td>
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<tr>
<td>Other</td>
<td>5.4%</td>
<td>1,510</td>
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#### 1999

- **World**: 28,212

### Japan's Total Iron and Steel Export by Country/Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
<th>Amount (1000 tons)</th>
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<tbody>
<tr>
<td>Asia</td>
<td>84.0%</td>
<td>34,639</td>
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<tr>
<td>U.S.A</td>
<td>4.9%</td>
<td>2,003</td>
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<tr>
<td>Middle East</td>
<td>3.6%</td>
<td>1,467</td>
</tr>
<tr>
<td>Europe</td>
<td>3.4%</td>
<td>1,416</td>
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<tr>
<td>Oceania</td>
<td>1.5%</td>
<td>612</td>
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<tr>
<td>Africa</td>
<td>1.1%</td>
<td>453</td>
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<tr>
<td>Other</td>
<td>1.6%</td>
<td>644</td>
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#### 2011

- **World**: 41,234

Unit: 1000 tons
Source: Japan Customs Statistics
Commitment to Technical Excellence: Japanese Mills Have More Steel Patents

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009 (1-11)</th>
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<tbody>
<tr>
<td>Japan</td>
<td>171</td>
<td>175</td>
<td>252</td>
<td>214</td>
<td>239</td>
<td>295</td>
<td>418</td>
<td>534</td>
<td>558</td>
<td>405</td>
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<tr>
<td>U.S.A.</td>
<td>165</td>
<td>181</td>
<td>184</td>
<td>177</td>
<td>177</td>
<td>159</td>
<td>150</td>
<td>151</td>
<td>194</td>
<td>103</td>
</tr>
<tr>
<td>S. Korea</td>
<td>8</td>
<td>15</td>
<td>21</td>
<td>11</td>
<td>20</td>
<td>16</td>
<td>25</td>
<td>36</td>
<td>52</td>
<td>35</td>
</tr>
<tr>
<td>China</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>4</td>
<td>14</td>
<td>18</td>
<td>28</td>
<td>29</td>
<td>29</td>
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Source: WIPO (World Intellectual Property Organization) Statistics Database, November 2009
### Commitment to Capital Investment: Comparison of CAPEX Per Ton

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<tbody>
<tr>
<td><strong>U.S. Mills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S. Steel</td>
<td>$30</td>
<td>$32</td>
<td>$30</td>
</tr>
<tr>
<td>Mittal</td>
<td>$55</td>
<td>$38</td>
<td>$37</td>
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<tr>
<td>Nucor</td>
<td>$50</td>
<td>$28</td>
<td>$19</td>
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<tr>
<td><strong>U.S. Avg.</strong></td>
<td><strong>$45</strong></td>
<td><strong>$33</strong></td>
<td><strong>$29</strong></td>
</tr>
<tr>
<td><strong>Japanese Mills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nippon Steel</td>
<td>$92</td>
<td>$115</td>
<td>$99</td>
</tr>
<tr>
<td>JFE Steel</td>
<td>$63</td>
<td>$95</td>
<td>$80</td>
</tr>
<tr>
<td><strong>Japan Avg.</strong></td>
<td><strong>$77</strong></td>
<td><strong>$105</strong></td>
<td><strong>$89</strong></td>
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</tbody>
</table>

Source: Company Annual Reports and Published Financial Data
High Value Added Products: Japanese exports to the U.S market

The proportion of high value added steel products in the volume of total Japanese steel exports to the U.S has steadily increased since 2005 while the absolute volume of high value added categories has been stable.

Method of Classification - Small number means higher value -
1. High-tensile Strength Steel/IF(Interstitial Free)Steel/Electrical Steel/Alloy tool steel, etc (steel products have high value characteristic)
2. EG/Tin plate/Tin free steel/clad steel, etc (regards as high value added steel products)
3. alloy steel
4. Others (non-alloy steels which are hard to define by HS as high value added products such as zinc corrugated steel)
5. Rejected sheets and plates
(※Higher grade is adopted if the products can be classified into more than one category)
High Value Added Products: Japanese exports for Automotive Industry to the World

- High tensile strength steels, IF steels and alloy tool steels as such products mostly used for automotive, the proportion of these products supply in high value added product group to the world has increased year by year from 76% in 2005 to 83% in 2011 led by expansion of the Japanese auto makers in emerging economies mainly in Asia. In these emerging economies, high value added steel products from Japan are required because the local steel makers cannot produce high quality steel products that the Japanese auto makers require.

**Definition of high value added steel products for automotive industry:** Base data was extracted High tensile strength steel, IF steel, alloy tool steel from category 1 as described in the previous page.
Japanese Specialty Products

- Japanese mills have developed a number of specialty steel products. Examples include:
  - Wear-resistant rails
  - Black chromate-free electrogalvanized steel sheets
  - High quality alloy oil pipe
  - Special steel wire rods and bars
  - Stainless Steel

- Japanese production and exports have increased focused on these specialty steel products
Commitment to Product Development: Japanese Specialty Products

- Nippon Steel’s HE Rail and ZINKOTE electro galvanized Steel Sheet
- JFE Steel’s Wear Resistant Premium Rail
- Sumitomo Metal’s High Strength OCTG
- Kobe Steel’s Automotive Wire Rods and Bars
- Nisshin Steel’s Advanced Stainless
HE Rail; Innovative Products

~Nippon Develops Newest Head Hardened Rail~

- Improvement of Wear Resistance
- Anti-Surface Defect
- Anti-Internal Defect
- Reduction of Total Cost of Customers

Hardness

Strength

HE Rail

HE-X 1.0% Carbon
HE400 0.9% Carbon
HE370 0.8% Carbon
DHH370 0.9% Carbon
NHH

Longer Life

Improvement of

- Wear Resistance
- Anti-Surface Defect
- Anti-Internal Defect

Nippon Steel Corporation
**JFE’s advanced rails**  - Superior Hardness and Wear Resistance -

**SP3 rail: Super Pearlire rail type 3**

SP3: Improved wear resistance with high hardness from the surface to inside of rail head.

Refining pearlite colony size is effective to improve hardness, wear resistance and rolling contact fatigue (RCF) resistance.

**Comparison of wear resistance**

<table>
<thead>
<tr>
<th></th>
<th>THH</th>
<th>SP</th>
<th>SP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.5</td>
<td>4.0</td>
<td>3.5</td>
</tr>
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</table>

- 25% improvement
- 20% improvement

**Comparison of RCF resistance**

<table>
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<th>THH</th>
<th>SP</th>
<th>SP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>16</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

- 13% Improvement
- 29% Improvement
"ZINKOTE™ Black" chromate-free electrogalvanized steel sheet
- Featuring workability, corrosion resistance, design and eco-friendliness.

“ZINKOTE™ Black” provides eco-friendliness as well

The "ZINKOTE™ Black" steel sheet uses the chromate-free electrogalvanized steel sheet of Nippon Steel as a substrate, on one side of which black paint is thinly applied.

Major characteristics of this product

- By using special low-temperature dryable paint, "ZINKOTE™ Black" achieves the use of thinner film than conventional coated steel along with a reduction of CO2 generation volume during manufacturing.

- By inline manufacturing on an electrogalvanized steel sheet manufacturing line (EGL), the coating process for conventional coated steel sheets is unnecessary, achieving process-saving.
High Strength and High Corrosion Resistant Alloy, Super 17Cr OCTG for Ultra Deep Well Application

Sumitomo Metal Industries, Ltd. (Sumitomo Metals) has developed a new martensitic stainless steel oil country tubular goods (OCTG), SM17CRS-125 (referred to as "Super 17Cr "). Super 17Cr has the best-in-class corrosion resistance and strength in martensitic stainless steel OCTG. This product will be used to meet the increasing demand in ultra deep well developments and contribute to maintain the world's energy supply.

1. Background of Development

For developing oil and gas wells, seamless OCTG are generally used because of their higher reliability. 13Cr martensitic stainless steel OCTG has been specifically used for applications containing carbon dioxide (CO2), because of its CO2 corrosion resistance.

In recent years, developments of deep wells over 6,000 meters have been increasing. As a consequence material requirements have become more stringent: Higher Yield strength to withstand increasing formation pressure and string weight as well as corrosion resistance up to 200ºC. In such environment, 13Cr OCTG cannot be used because of stress corrosion cracking (SCC) limitation, and higher grades duplex stainless steel OCTG have been used instead.

Duplex stainless steel OCTG, due to 22-25% Chromium content, has a better CO2 corrosion resistance and can be used up to 200ºC. However, its cost is driven up by the significant amount of noble alloying elements such as nickel and molybdenum and its cold working process required to obtain its mechanical properties.
2. Characteristics of Super 17Cr

(1) Corrosion resistance for ultra deep gas wells containing CO2

Generally, larger content of chromium is required to prevent SCC in a high temperature and CO2 environment. Sumitomo Metals has found that 17% chromium is optimal to ensure corrosion resistance required for ultra deep CO2 containing wells.

(2) Strength required for ultra-deep wells

Fig 1: Microstructure of Super 17Cr Steel

With 17% chromium, the material structure cannot be single phase of hard martensite, but dual phase containing some soft ferrite (refer to Fig 1).

However, by optimizing other alloying elements, Sumitomo Metals succeeded to achieve 125ksi (861MPa) grade, which exceeds the general yield strength level of 13Cr; 80ksi-110ksi*7 (551-758MPa) grade without cold working process.
Wire Rods and Bars for Automobile

Valve Spring

Bolt

Connecting rod

Engine

Crank shaft

Steel cord

Differential gear

Gear

Steel radial tire

Automobile

Pulley

Gear

Ball Joint

Suspension spring

Pinion

Part

Chassis

Rack

Part

Bearing
What is DNA-SUS?

DNA-SUS have 3 categories.

Category 1: Series of unique steel grades with superior properties. (NSS series)

Category 2: Coated / Painted stainless steel products.

Category 3: Special products.

Include superior buffing grade materials.

Customer-oriented high value-added stainless.

Disk brake

Exhaust manifold

IH rice cooker (Pearl-toned transparent paint)

Building exterior