EXPLORING THE FUTURE
OF STEEL MANUFACTURING

MAXIMIZATION OF
CONTINUOUS CASTING AND
ROLLING

“ARE REHEATING FURNACES
A THING OF THE PAST?”
<table>
<thead>
<tr>
<th>Processes and Technologies</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Electric Arc Furnaces</td>
</tr>
<tr>
<td>Secondary Metallurgy Stations</td>
</tr>
<tr>
<td>Casting Strands for Slabs, Blooms and Billets</td>
</tr>
<tr>
<td>Slab, Bloom and Billet Grinding Machines</td>
</tr>
<tr>
<td>Direct Reduction Plants</td>
</tr>
<tr>
<td>Blast Furnace and Converter Projects</td>
</tr>
</tbody>
</table>
# Processes and Technologies

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>HOT STRIP, PLATE AND COLD MILLS</strong></td>
</tr>
<tr>
<td><strong>HEAVY SECTION, RAIL, BAR AND WIREROD MILLS</strong></td>
</tr>
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<td><strong>ALUMINIUM HOT AND COLD MILLS</strong></td>
</tr>
<tr>
<td><strong>STRIP PROCESSING LINES</strong></td>
</tr>
<tr>
<td><strong>DRAWING AND PEELING MACHINES</strong></td>
</tr>
</tbody>
</table>
Casting speeds in excess of 6 m/min (236 ipm) for Billets and Slabs to allow for Continuous Casting & Rolling of Long and Flat Product
Lower CAPEX because smaller but with the same OPEX of a large minimill. That's why it is more profitable.

Productivity ranges from 0.2 to 1Mtpy of straight bars, wirerod, spooled coils and small sections.
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MI.DA® DANIELI MICROMILL CONCEPT
FOR LONG PRODUCT – 500K TPY
1. Hot wind and EAF area
2. Caster area
3. Rolling mill 1 area
4. Rolling mill 2 area
**Meltshop**

- 10,300 + heats/year
- < 32 min avg. power-on time
- 45 min avg. T-t-T time
- 335 kWh/ton
- EAF consumption

**Caster**

- 6.35 m/min average casting speed (130mm billet)
- >99.3% yield
  (crops, billets, etc.)
- 32-35 heats avg. sequence length

**Rolling mill**

- 50 TPH rolling rate
- >99.4% mill yield
- 99.4% operating time in endless mode
  (balance is transitions during which mill operates in semi-endless mode)
Plant highlights

90% plant utilization rate

> 32-35 heat sequence on day-to-day basis
> up to 50 heat sequences

> 39,370 ft longest cast billet in continuous mode
> 1,300+ ton production per day
> 1,000 hrs average caster mould life (>50,000 tons)
Danieli has pioneered EWR technologies having capability to integrate it on existing and new plants to:

- Increase Productivity by 12-14 % and Material Yield up to 99% thanks to:
  - Elimination of interbillet time
  - Minimization of scrap material (crops, shorts, less cobbles)
  - Higher rolling speeds (better process stability)

- Improve the homogeneity of characteristics and rolled material quality

- More flexibility and efficiency in Production Planning

- Result: 3.5 to 4.5 Euro/ton savings in production cost (longer life of equipment, lower usage of consumables, reduced spares and maintenance)
MATERIAL YIELD
With 100 welding in sequence, benefits exploited almost to the fullest

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DANIELI ENDLESS WELDING ROLLING (EWR)
THE CLOSEST TO ENDLESS CASTING & ROLLING

2.5-t billet
2-t billet
1.5-t billet
1-t billet

Material yield (%) vs. Number of billets welded together
PAYBACK AS FUNCTION OF THE YEARLY PLANT CAPACITY

EXPLORING THE FUTURE OF STEEL MANUFACTURING
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PAYBACK PERIOD (MONTHS)

Yearly plant capacity (tpy)

100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000

Sq. billet 130 x 12,000 mm

Sq. billet 150 x 12,000 mm
> ENVIRONMENTALLY FRIENDLY SOLUTION
> ADVANCED TEMPERATURE CONTROL ➔ CONSTANT ROLLING TEMPERATURE
Optimized consistency, induction heating eliminates the quality issue associated with open flame, torch heating and similar methods.

Maximized productivity, because heat is developed directly and instantly inside the material being heated.

Environmental friendly, no gas consumption, Induction heating does not burn traditional fossil fuels. As a consequence it’s a safer process by eliminating waste heat, emissions and noise.

Reduced energy consumption, considering it’s a energy-efficient process that converts up to 90% of the energy into useful heat.

Lower maintenance cost, inductors and electric controls require much less maintenance compared with gas furnace.

Delay and consumption benefit, considering that the heating is immediately available

Scale formation reduction, Increased Plant Yield, very fast heating process implies no scale formation. Up to 0.5% - 0.8% better yield.

No black Spots. Induction heating technology do not cause black spots on billet surface (due to contact between RHF beams and billet) allowing to reach temperature uniformity along billet length.

Better quality of final product, no-contact of the material to be heated with a direct flame smaller deviations of mechanical properties along the length of the product (bar or coil). Constant Temperature, leads to a better control and more uniform result of quenching process.
EXPLORING THE FUTURE OF STEEL MANUFACTURING
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“ARE REHEATING FURNACES A THING OF THE PAST?”

DANIELI Q-HEAT
HOT CHARGE VIA INDUCTION HEATING
AND BILLET WELDING

Induction Furnace #2
Existing Reheat Furnace
Billet Reject
Billet Welder
Rolling Stand #1
Deburring Unit
Induction Furnace #1
Relocated Billet Transfer
Existing Caster
> BILLETT FROM CCM
> QHEAT BEFORE ROLLING MILL
> GAS FURNACE OFF
> CCM MODIFICATION
> 8 €/ton OPEX SAVING

OLD WAY
(gas furnace)

NEW WAY
(induction furnace)
**Scale formation reduction**
very fast heating process implies
no scale formation

**Increased plant yield**
up to 0.5% - 0.8%
Commercial and high added-value grades (pipe line, automotive, etc.) offering Wide strip thickness range 0.8 - 25 mm
<table>
<thead>
<tr>
<th>Low Carbon</th>
<th>High Strength Low Alloy</th>
<th>Complex Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Low Carbon" /></td>
<td><img src="image2" alt="High Strength Low Alloy" /></td>
<td><img src="image3" alt="Complex Phase" /></td>
</tr>
</tbody>
</table>

**A WIDE PRODUCT MIX**

- **Low Carbon**
- **High Strength Low Alloy**
- **Complex Phase**
- **Medium Carbon**
- **API Pipeline**
- **Advanced High Strength Steel**

**DUE™ - DANIELI UNIVERSAL ENDLESS CONCEPT**

**A WIDEN PRODUCT MIX**

“ARE REHEATING FURNACES A THING OF THE PAST?”

**EXPLORING THE FUTURE OF STEEL MANUFACTURING**

**MAXIMIZATION OF CONTINUOUS CASTING AND ROLLING**
Uninterrupted casting-rolling

Coil generated by the high-speed shear before the downcoiler
One slab for each coil

Slab generated by the pendulum shear in front of the tunnel furnace
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DUE™
DANIELI UNIVERSAL ENDLESS CONCEPT
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MAXIMIZATION OF CONTINUOUS CASTING AND ROLLING
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INTELLIGENT MILL – Q3 INTELLIGENCE
FROM LIQUID TO COIL: A SELF-LEARNING TECHNOLOGY

DIGIMET AUTOMATION
Data generation in modern steel plants is a continuous and automated process. Data volume is constantly increasing and taking use of the information is becoming important to manage the operations.
<table>
<thead>
<tr>
<th>DATA SOURCES</th>
<th>Background data acquisition procedures from all the L2 systems</th>
<th>REAL-TIME DASHBOARDS</th>
<th>Real-time fully configurable web dashboards for all plant areas. Enhanced visualization with the adoption of a top-down approach that starts with the evaluation of Key Performance Indicators (KPIs) and tracks production down to single day/heat details.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA WAREHOUSE</td>
<td>A custom-tailored and well documented DWH to store GB of data and to make it available to front-end applications: a unified view of actual and historical plant performances.</td>
<td>DYNAMIC REPORTS</td>
<td>Boosted data analysis capabilities. From anywhere within the company network, users with varying responsibilities have the possibility to explore historical production data via ready-to-use custom Excel dynamic analysis templates.</td>
</tr>
<tr>
<td>WEB PORTAL</td>
<td>Web Portal provides role-based access to data; completely integrated with Active Directory, it easily fulfills the need for high-level restrictions.</td>
<td>STATISTICAL ANALYSES</td>
<td>Consolidated statistical methodologies are implemented into dynamic Excel worksheets. Robust checks and verification tasks of fresh production data by means of univariate and multivariate analyses, linear and non-linear regressions, control charts.</td>
</tr>
</tbody>
</table>

**Q3 INTELLIGENCE OVERVIEW**

**EXPLORING THE FUTURE OF STEEL MANUFACTURING**

**MAXIMIZATION OF CONTINUOUS CASTING AND ROLLING**

**“ARE REHEATING FURNACES A THING OF THE PAST?”**
Q3 Intelligence system answers an important need: to provide specific information sets for different user profiles within a company.

<table>
<thead>
<tr>
<th>Role</th>
<th>Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLANT MANAGER</td>
<td>Needs to monitor plant performance in order to improve utilization, yield and productivity.</td>
</tr>
<tr>
<td>QUALITY ASSURER</td>
<td>Needs to find events and relationships that affect the quality of the products.</td>
</tr>
<tr>
<td>PROCESS ENGINEER</td>
<td>Needs to investigate metallurgical aspects of the process.</td>
</tr>
<tr>
<td>PLANNING MANAGER</td>
<td>Needs to analyze past schedule to improve planning performance.</td>
</tr>
<tr>
<td>MAINTENANCE MANAGER</td>
<td>Needs to maximize assets utilization and to reduce downtimes.</td>
</tr>
<tr>
<td>WAREHOUSE MANAGER</td>
<td>Needs to monitor warehouse activities and understand inefficiencies to improve material handling.</td>
</tr>
</tbody>
</table>
**Q3 INTELLIGENCE WEB DASHBOARD**

**Q3-Inelligence Business Intelligence for the metals industry**

**Electric Arc Furnace Dashboard > Production Dashboard**

**Total Number of Heats [#]**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Best</th>
<th>Worst</th>
</tr>
</thead>
<tbody>
<tr>
<td>A93227</td>
<td>209.42</td>
<td>72.91</td>
</tr>
<tr>
<td>B93217</td>
<td>90.26</td>
<td>74.78</td>
</tr>
<tr>
<td>B93270</td>
<td>90.26</td>
<td>79.30</td>
</tr>
<tr>
<td>A93228</td>
<td>94.31</td>
<td>79.49</td>
</tr>
<tr>
<td>A93229</td>
<td>94.14</td>
<td>79.69</td>
</tr>
</tbody>
</table>

**Liquid Yield [%]**

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>A93227</td>
<td>109.42</td>
<td>72.91</td>
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<td>94.14</td>
<td>79.69</td>
</tr>
</tbody>
</table>

**Productivity [Ton/h]**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Best</th>
<th>Worst</th>
</tr>
</thead>
<tbody>
<tr>
<td>A93227</td>
<td>2,727.02</td>
<td>6.09</td>
</tr>
<tr>
<td>B93217</td>
<td>90.26</td>
<td>74.78</td>
</tr>
<tr>
<td>B93270</td>
<td>90.26</td>
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<td>94.14</td>
<td>79.69</td>
</tr>
</tbody>
</table>

**Power On [min]**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Best</th>
<th>Worst</th>
</tr>
</thead>
<tbody>
<tr>
<td>A93227</td>
<td>33355</td>
<td>33355</td>
</tr>
<tr>
<td>B93217</td>
<td>90.26</td>
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<tr>
<td>B93270</td>
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<td>94.14</td>
<td>79.69</td>
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</tbody>
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**Adds [Bc/Ton]**

<table>
<thead>
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<th>Best</th>
<th>Worst</th>
</tr>
</thead>
<tbody>
<tr>
<td>A93227</td>
<td>322.73</td>
<td>42.49</td>
</tr>
<tr>
<td>B93217</td>
<td>90.26</td>
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<td>94.14</td>
<td>79.69</td>
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</table>

**Production Rate [%]**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Best</th>
<th>Worst</th>
</tr>
</thead>
<tbody>
<tr>
<td>A93227</td>
<td>4892</td>
<td>33355</td>
</tr>
<tr>
<td>B93217</td>
<td>90.26</td>
<td>74.78</td>
</tr>
<tr>
<td>B93270</td>
<td>90.26</td>
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<tr>
<td>A93229</td>
<td>94.14</td>
<td>79.69</td>
</tr>
</tbody>
</table>

**Tap To Tap Time [hh mm ss]**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Best</th>
<th>Worst</th>
</tr>
</thead>
<tbody>
<tr>
<td>A93227</td>
<td>6m 00s</td>
<td>12h 34m 00s</td>
</tr>
<tr>
<td>B93217</td>
<td>90.26</td>
<td>74.78</td>
</tr>
<tr>
<td>B93270</td>
<td>90.26</td>
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<tr>
<td>A93229</td>
<td>94.14</td>
<td>79.69</td>
</tr>
</tbody>
</table>

**Electric Arc Furnace Dashboard**

- **Shop Date**: 11/01/2016
- **Heat**: 6025
- **Start Time**: 5:49:22 AM
- **Shop Time**: 6:49:00 AM
- **Crew**: 295.901
- **Charged Weight [lbs]**: 8,211,404
- **DRI**: 1,017,000
- **Target Weight [Ton]**: 5,513.49
- **Liquid Yield [%]**: 94.53
- **Productivity [Ton/h]**: 22.37
- **Production Rate [%]**: 72.92
- **Power On [min]**: 33356
- **Power On [%]**: 34.25
- **Power On [kW]**: 42.1
- **Power On [V]**: 440.0
- **Power On [A]**: 72.92
- **Power On [Ohm]**: 33.35
- **Power On [%]**: 34.25
- **Power On [kW]**: 42.1
- **Power On [V]**: 440.0
- **Power On [A]**: 72.92
- **Power On [Ohm]**: 33.35

**Crystal Report**

**External link**

**Crushed Heat Report**

**Intial Heat Report**

**Actual Value**

- **112,503,739**
- **36,435,000**
- **47,062,27**
- **209h 40m 00s**

**Grand Total**

- **375**
- **43**

**MAXIMIZATION OF CONTINUOUS CASTING AND ROLLING**

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Q3 INTELLIGENCE
DYNAMIC REPORTS & STATISTICAL ANALYSIS

PivotChart Fields
Show Fields
- Chemical analysis
  - Average Quantity per Heat
  - Average Quantity per Ton
  - Average Powder
    - Molten Cast Powder (lbs/Ton)
    - Powder (lbs/Ton)
- Total Quantity
- Delays
  - Calendar Times
  - Delays
- Plant Performance Indexes
- Process Variables
  - Average Value (AVG)
  - Max Value (MAX)
  - Min Value (MIN)
  - Set Value (SET)
  - Standard Deviation Value (STDV)
- Production
  - Current
  - Heat
  - Indexes
  - Semi-product
  - Sequence

- Quality Control System Results
  - Number of Sections per Defect
  - Percentage of Sections with Defect
  - Total Number of Section Defects
  - AVG Defects per Section
  - Number of Section Defects
  - Sections with Defects
  - Sections with Defects%
  - Stab Defects

- Samples
  - Oxygen
  - Temperature
- Sigma Analysis
  - First Analysis (FSA)
HOME

MENU

KPI LIST

KPI DETAIL

PRODUCTION DETAIL

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Q3 INTELLIGENCE ON MOBILE DEVICES

DANIELI
EXPLORING THE FUTURE OF STEEL MANUFACTURING
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Q3 INTELLIGENCE NEW PULPIT CONCEPT
RIVA THY MARCINELLE, BELGIUM

1 pulpit for EAF and LF and charging crane
EXPLORING THE FUTURE OF STEEL MANUFACTURING
MAXIMIZATION OF CONTINUOUS CASTING AND ROLLING
“ARE REHEATING FURNACES A THING OF THE PAST?”
> 6.35 m/min casting speed

> 1,050 °C stand #1 entry temperature

> INDUCTION FURNACE NOT IN USE!
EXPLORING THE FUTURE OF STEEL MANUFACTURING

MAXIMIZATION OF CONTINUOUS CASTING AND ROLLING

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