Industry 4.0 in Steel: Status, Strategy, Roadmap and Capabilities
Keynote Presentation Future Steel Forum, Warsaw

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The steel industry is facing significant challenges due to cost, regulatory, product and service requirements.

**Metals business challenges**

### Product requirements
- Shift from commodity steel towards heterogeneous product portfolio
- Applications towards stronger and more durable steel
- Shorter product-life-cycles in downstream business

### Cost pressure
- Increased exports from China as well as stagnating Chinese economy
- Lower demand from Russia due to weak currency and sanctions
- Increasing overcapacity in European plants
- Slowed down market growth at only 1.8% CAGR in Europe results in weakened demand

### Process complexity and service requirements
- Shorter innovation cycles down-stream and increased share in project-based business urge flexible use of capacity and reliable delivery of products
- Heterogeneous product portfolio and small batch size in special steel need to be optimized (focus on service and flexibility)

### Regulatory requirements
- Ambitious CO2 regulations boost certificate trading and cause additional costs
- Sustainability efforts in downstream business
- Efficient use of resources and energy
Metals CEOs plan for growth fueled by efficiency, innovation and digitization

Metals CEOs are looking to drive growth organically through cost reduction and investment in innovation

Which of the following activities, if any, are CEOs planning in the coming twelve months in order to drive corporate growth or profitability?

- **Organic growth**: 78%
- **Cost reduction**: 69%
- **New M&A**: 31%
- **New strategic alliance / JV**: 28%
- **Outsourcing**: 28%

Which one of the following do CEO's most want to strengthen to capitalize on new opportunities?

- **Innovation**: 25%
- **Competitive advantage**: 19%
- **Customer experience**: 13%
- **Cost containment**: 13%
- **Human capital**: 13%

To what extent has technology changes competition in your industry over the...

- **Past 5 years**
  - No impact: 40%
  - Moderate impact: 20%
  - Significant impact: 20%
  - Complete reshaped: 20%

- **Next 5 years**
  - No impact: 20%
  - Moderate impact: 40%
  - Significant impact: 20%
  - Complete reshaped: 20%

- 59% of Metals CEOs think that technology will be game changer for the industry and will reshape competition over the next five years.
- We see significant potential in the digitization of processes in the supply chain, production, sales & marketing and administration.
- In volatile business environments with demanding customers, digitization provides more agility in asset-intensive industries like metals and enables significant differentiation.
- While digitization requires a significant portion of capital expenditure, it’s fundamental to company strategy and a sustained competitive advantage in the future.
Industry 4.0 featuring the digital enterprise combines vertical and horizontal integration with customer access & business models.
From talk to action – Industry 4.0 is moving from strategic hype to operational reality

High Level of digitization and integration today and in the next five years

High level of digitization today

33%

+39%

72%

High level of digitization in 5 years

High level of digitization and integration today

and in the next five years

Percentage of companies reporting high degrees of digitization and integration today/in five years for selected operational functions

Vertical value chain integration

41%

72%

Horizontal value chain integration

34%

65%

Digital business models, product and service portfolio

29%

64%

Product development & engineering

42%

71%

Customer access/ Channels & marketing

35%

68%

Shown: Percentage of companies surveyed reporting high degrees of digitization and integration (4 or 5 on a scale of 1 “very low” to 5 “very advanced”)

Source: PwC Strategy& Global Industry 4.0 Survey 2016

PwC’s Digital Services

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Fundamental business model transformation follows five key trends

<table>
<thead>
<tr>
<th>Business model transformation</th>
<th>Drivers</th>
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</table>
| STRATEGY: I 4.0 becomes strategically important to generate competitive advantages | • Strong focus of management board  
• High value add (product mix, costs, inventories)  
• Pressing customer demand (Auto) and economics |
| SEQUENCE: The horizontal integration with customers builds vertical process management. | • Focus on production: Energy, Yield, Quality  
• Then: New service and business models for MRO, supply chain management and steel service centers |
| CAPABILITY: Steel producers will further control the steel making process and know-how. | • Successful development of big data and sensor tech.  
• Closeness of physical and business processes  
• Risk: Cyber Security, Ownership of IP |
| ROADMAP: I 4.0 is driven via integrated roadmaps with multiple waves across functions | • 1. wave: process automation within MRO  
• 2. wave: SC Integration with Tracking, QM, R&D  
• Continuously: Analytic capabilities, business case |
| INTEGRATION: I 4.0 leads to the integration of processes, organization and reduced barriers | • Customer and value add processes  
• Breakup of barriers: functions and business  
• Aligned and value driven steering models |
First use cases for wave one processes are constituting...

Digitalization revolutionizes the steel industry

Use Cases

1. Improve quality and efficiency of steel production via Data & Analytics
2. Improve maintenance productivity via high-precision Tracking Systems
3. Increase facility transparency, quality and efficiency via Drones
4. Advance price and quantity forecasting via Predictive Analytics
5. 3D printing solutions for spare parts

Wave 1: Vertical Integration
- Asset configuration
- Resource availability
- Process quality
- Product quality
- Maintenance Management
- Sensor/actuator data

Wave 2: Horizontal Integration
- Supplier
- E2E network capacity
- Inventory levels
- Location/track & trace
- Quality information
- Customer demand

Source: Fraunhofer IAIS (2015), Strategy&
Using available sensor, process and quality data for the steering of the electric arc furnace at client’s site

- Optimize process efficiency and costs
- Increase product quality
- Get real-time transparency on current product conditions
Predictive analysis improves price and quantity forecasting

- Use of data & analytics to predict maintenance and repair situations
- Optimize maintenance and repair cycle due to optimized planning and real time alerts
- Remote, dynamic monitoring machines conditions
- OEMs to expand from product into service business

Leading steel player leverages industry 4.0 to consolidate and analyze data allowing predictive maintenance & remote support
Improve maintenance people and work shop productivity through traceability:

- Improve work shop layout and area occupation
- Improve utilizations by adapting tracking results into routines
- Optimize routings and navigation to assets, tools and spare parts
- Reduce unnecessary idle / waiting times and pathways
- Accelerate repair duration

WORKSHOP CLIENT EXAMPLE
Drone technology to increase stock transparency and facility efficiency:

- Facilitate measurements of difficult to access objects & mitigate risky operation
- Decrease time and costs for inspection procedures
- Avoid process interruptions by real-time structural fracture identification
- Speed-up measurement of arrived bulky stocks
- Quality / speed of stock and volume inspection
Advanced price and quantity forecasting:

- Use a broad range of driver and input factors
- Automate relevant drivers selection and optimized explanation model creation
- Apply advanced forecast modelling technics like Econometric Regression or Neuronal Networks
- Recognizes changes within the drivers adapt machine learning techniques

For the forecast...

... the individual drivers are simultaneously predicted into the future by and through:

- ARIMA-Models
- MReg-Models
- VAR-Models
- Neural Networks
- ...

Benefit:
Combination of econometric models with expert knowledge
3D printing revolutionizes spare part business

- Innovative 3D printing technology to print spare parts
- Manufacturing of strong, light parts while reducing production time and cost
- On demand replication of spare parts
- Short-term delivery enables significant reduction in spare parts inventory
- Infrastructure not bound to production facilities

Benefits

- Simplified supply chain – fewer suppliers
- Lower labor units and transport cost
- No need to “follow cheap labor rates”
- Local and quick delivery
- Reduced inventory cost
- Low cost and fast delivery

Simplification through 3D printing

Traditional way

Supply Chain: ~50 parts shipped in from different places
Production: Production offshore in low-cost location
Delivery: Multi-stage delivery
Support: Shipped in from large inventory

3D Printing

Supply Chain: 5 components/materials shipped in
Production: Production near customer
Delivery: Local van delivery
Support: Printed on demand and delivered same day

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Industry 4.0 and Digital capabilities develop across six dimensions and four stages

### PwC Strategy & Digital Maturity Assessment

<table>
<thead>
<tr>
<th>Digital products &amp; services</th>
<th>Market &amp; customer access</th>
<th>Value chains, processes</th>
<th>IT Architecture</th>
<th>Compliance, legal, risk, security &amp; tax</th>
<th>Organization &amp; culture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I Digital Novice</strong></td>
<td><strong>II Vertical Integrator</strong></td>
<td><strong>III Horizontal Collaborator</strong></td>
<td><strong>IV Digital Champion</strong></td>
<td></td>
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<tr>
<td>First digital solutions and isolated applications</td>
<td>Digital product and service portfolio with software, network (M2M) and data as key differentiator</td>
<td>Integrated customer solutions across supply chain boundaries, collaboration with external partners</td>
<td>Development of new disruptive business models with innovative product and service portfolio, lot size 1</td>
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<tr>
<td>Online presence is separated from offline channels, product focus instead of customer focus</td>
<td>Multi channel distribution with integrated use of online and offline channels: Data analytics deployed, e.g. for personalization</td>
<td>Individualized customer approach and interaction together with value chain partners</td>
<td>Integrated Customer Journey Management across all digital marketing and sales channels with customer empathy and CRM</td>
<td></td>
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</tr>
<tr>
<td>Digitized and automated sub processes</td>
<td>Vertical digitization and integration of process and data flows within the company;</td>
<td>Horizontal integration of processes and data flows with customers and external partners, intensive data use</td>
<td>Fully integrated partner ecosystem with self-optimized, virtualized processes decentralized autonomy</td>
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</tr>
<tr>
<td>Fragmented IT architecture inhouse</td>
<td>Homogeneous IT architecture inhouse</td>
<td>Common IT architectures in partner network</td>
<td>Partner service bus, secure data exchange</td>
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</tr>
<tr>
<td>Traditional structures, digitization not in focus</td>
<td>Digital challenges recognized but not comprehensively addressed</td>
<td>Legal risk consistently addressed with collaboration partners,</td>
<td>Optimizing the value chain network for legal, compliance, security and tax</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional focus in „silos“</td>
<td>Cross functional collaboration but not structured and consistently performed</td>
<td>Collaboration across company boundaries, culture and encouragement of sharing</td>
<td>Collaboration as a key value driver</td>
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</tbody>
</table>
The I4.0 initiatives can be mapped onto a roadmap realizing quick wins and identifying long term development needs.

<table>
<thead>
<tr>
<th>Data analytics and big data</th>
<th>Digital products and services</th>
<th>Digital value chain and processes</th>
<th>Digital business models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term (&lt; 1y)</td>
<td></td>
<td>Long-term (&gt; 3y)</td>
<td></td>
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<tr>
<td>Digital maintenance data and user manuals</td>
<td>Confirmed service levels within supply chain, machines, maintenance, etc.</td>
<td>Management of resource line of comprehensive supply networks</td>
<td>Disintegration of highly agile production networks</td>
</tr>
<tr>
<td>Customer/industry specific measurements</td>
<td>Big data for sales, products and OAE/OAC etc.</td>
<td>New products e.g. smart components</td>
<td>New products ideas like “Product in transit”</td>
</tr>
<tr>
<td>Digitalization of products e.g. sensors</td>
<td>Digital applications e.g. e-Maintenance</td>
<td>Resource Performance management (real-time, proactive)</td>
<td>Steering of customer demand via online application support</td>
</tr>
<tr>
<td>Early warning indicators and framework</td>
<td>Digital offerings e.g. e-platforms and connection to WWW</td>
<td>End-to-end Production &amp; Supply Chain solutions</td>
<td>Services for end user e.g. OEM</td>
</tr>
<tr>
<td>Use of mass data for product innovation and resource optimization</td>
<td>Resource Performance management (real-time, proactive)</td>
<td>Modularization of resources with higher rate of confirmation</td>
<td>Innovative collaboration and new product developments</td>
</tr>
<tr>
<td>Digital offerings e.g. e-platforms and connection to WWW</td>
<td>Intelligent packaging (incl. product information)</td>
<td>Transparency of usage for direct and indirect customers</td>
<td>New products e.g. operation of resources</td>
</tr>
<tr>
<td>Digital applications e.g. e-Maintenance</td>
<td>Benchmarking resource performance and management</td>
<td>Value added processes and services at customer location</td>
<td>New/direct sales channels</td>
</tr>
<tr>
<td>End-to-end Production &amp; Supply Chain solutions</td>
<td>Logistics transparency (track and trace)</td>
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**Industry 4.0 Leadership**

CLIENT EXAMPLE
Thank you!

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