The Impact of Digitalization to the Steel Industry – A Plant Engineering Point of View

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How to guarantee 100% quality?
How to maximize improvement potential?
How to give 100% transparency?
How to dig the latest secrets?

- Be focused on Process and Product Data
- Adapt a digital strategy
- Apply latest analytical, state of the art statistical methods
- Verify with Experience and Know How
Utilisation of state of the art statistical methods, neuronal networks, cluster analytics, pattern recognition and data mining solutions offer the perspectives for new understanding of process and products.
Vision „Smart Factory in Steel Industry“

- Future-oriented development of steel products
- Economic and flexible production of steel
- 2 % annual productivity increase
- Resource and environment consideration

Where can digitalization help to improve?

Future-oriented development of steel products
Economic and flexible production of steel
2 % annual productivity increase
Resource and environment consideration
Digital Impact in a „Smart Steel Factory“

- Effecting entire value chain starting in supply network ending in customer network (horizontal value chain)
- Change of internal processes from product development to product sales and services (vertical value chain)
- Transformation of company towards modified added value

How can digitalization help to improve?
Industrie 4.0 – The German Way of Digitalization and Digitization

SMS group as a Front Runner

Industrie 4.0 - Industrial transformation

◆ M2M, M2H connectivity
◆ Smart data analytics
◆ Shorter innovation cycles
◆ Changes in value chain from cost to value added products/services

SMS group

◆ Front runner in VR: “Digital Workshop”
◆ Integration test: “Plug & Work”
◆ Training: “Virtual Twins”
◆ Digital innovation: “Ideation Lab 4.0”

Huge potential for organization changes, plant, process and quality improvements!
Introduction

Smart Engineering/Smart Automation – Interdisciplinary Product Design in SMS group

Digital Workshop - Virtual Engineering

- Functional check of the automation solution in the context using real automation components
- Interface checks, pre-optimized automation parameter, customer training
- Safeguard of order handling times and costs
- Short-time commissioning and good product quality from the beginning

- Geometric safeguarding of the construction in the context of a multi-user environment
- Integration test of the construction i.e. virtual system check (geometric, dynamic, functional, safety-related)
- Geometrically verified of manufactured items in an early process stage
- Safeguard of the order handling times and costs

Plug & Work – Smart Automation

Start of manufacturing and operation only after completion of virtual commissioning.
SMS group – “Ideation Lab 4.0”
Ideation Lab 4.0 – SMS group Approach Follows Design Thinking Using Lean Start-up Methods

UNDERSTANDING CUSTOMER NEEDS

Identifying pain points through interviews and observations

RAPID PROTOTYPING

Testing of mockups to validate first ideas and get new insights

FIRST LIVE PRODUCT (MVP)

Developing minimum viable products for real sales tests

COMPANY BUILDING AND SCALING

Fast and KPI-based market rollout

Continuous user testing, validation and optimization

Ideation lab works since September on identification of pain points and solution development

> 150 External and internal interviews

> 100 Digital „Use cases“ defined

10 Use cases validated

5 MVPs validated
Digital Tools and Systems
HD LASr Digitalization of Mold and Segment Shops in Continuous Casting

Idea Description
- Digitalization of the complete mold and segment alignment process for all different continuous casters

Value Proposition
- Increased maintenance quality and decreased maintenance costs
- Maximum precision, reproducibility and reliability with use of laser tracker and HD LASr App
- Transfer of alignment data in maintenance management system and superior data base system to predict product quality
- Maintenance – calibration of tools & segment stand for one strand savings over 3 years: > 100,000 USD

Product Status
- System developed together with Salzgitter Flachstahl
- IoT solution order under execution
Real-time Ladle Tracking via RFID/IR-Pattern Technology in Meltshop Operation

Idea Description
- Real-time ladle tracking with RFID or IR ladle detectors
- Complete digitalization of all processes related to ladle management
- 2D and 3D temperature models of ladle body, refractory and melt

Value Proposition
- Create transparency in the ladle temperature control to optimize availability and logistics for energy savings
- Integration of ladles, ladle fires, cranes etc. and their logistics
- Use of temperature data to improve BOF/EAF tapping temperature

Product Status
- Product under commissioning at ArcelorMittal Bremen
- Improve ladle logistics, use of new tapping temperature settings
Quality Execution System
Proactive Production Supervision and Control
Big Data and AI in Production and Process Control

BOF Converter (Data driven Process Model)

Idea Description
DdPM for the BOF-Converter process
Applied methods: Regressions, SVP, Deep learning
Prediction of the T, [%C], [%P], (%Fe) at the end of blow
Adaption to inaccurate data of raw materials and wear during converter operation campaign

Value Proposition
Higher accuracy - lower re-blowing/overblowing rate
Reduced refractory wear
Reduced cooling/heating charge
Increased productivity

Product Status
Solution implemented at Dillinger Hütte and AM Ghent
Roll-out at further BOF Converters
Idea Description

- Software solution to allow the data access to all measuring and technology data along process chain – Data transparency
- Visualization and evaluation of content information data
- Material tracking and product preview in real-time

Value Proposition

- Implementation of domain know-how and customer requirements
- Grading of product, quality and quality certificates
- Automatic quality decision support for all production steps
- Proactive production supervision i. e. assign actions

Product Status

- Several reference installations in different steel plants
PQA - Material tracking and genealogy – features

- Product traceability over all production stages
- *Upstream* & *downstream* measurement data gets mapped onto the current product and recalculated accordingly with use of tracking information

- Not Relevant!
- Feed forward information

- Not Relevant!
- Feed forward information

- Relevant violation?
- Feed forward information

Reduce rolling speed at TCM

Measurement & Tracking & Data collection
PQA: The view on product quality using genealogy data

Synchronized view across all process steps
PQA - Process and Quality control (Caster example)

Mold level
Stopper position
Casting speed
Tundish/ ladle weight
### PQA References – Plant monitoring, Process and Performance optimisation

<table>
<thead>
<tr>
<th>Company</th>
<th>Projects/Activities</th>
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<tbody>
<tr>
<td>BIG RIVER STEEL</td>
<td>• EAF – CSP Mini-Mill including cold rolling and CGL</td>
</tr>
<tr>
<td>SHANDONG STEEL</td>
<td>• BOF, CC including HSM, PLTCM, HDG, CGL and Plate mill</td>
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<tr>
<td>BENXI STEEL</td>
<td>• CGL and CAL</td>
</tr>
<tr>
<td>PT KRAKATAU</td>
<td>• HSM</td>
</tr>
</tbody>
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**New:** Contract with a leading European SBQ producer covering the complete process chain
Service Platform Solution for Spare Part Identification

Idea Description
- Establish eService as a digital channel to customers
- Efficient tool for our customers to be used day-to-day for central documentation and convenient procurement of spares

Value Proposition
- Transparency in documentation of existing knowledge and equipment
- Minimization of network capital costs by identification of similar parts
- Easy, quick and simple identification using coding or linked drawings (mechanics and electrics) and other documents
- Intuitive access and display of content, integration of “shopping carts” for handling spare part procurement
- Connection to customer ERP system to follow purchase formalities

Product Status
- MVP presented at Tube and Wire” 2016
- Full customer implementation for Big River Steel, USA
- Two further customers solutions in demonstration phase
Logistics – “Smart Production”
Augmented Operation – High-bay Warehouse for Coils

Idea Description
- Transparent communication in the supply chain using digital twin in combination with sensor tracking for products, transport devices etc.
- In order to organize itself, the product (e.g. coil) contains information regarding customer order, process route in past and future, properties and quality

Value Proposition
- Fully automated operation of logistics in slab and coil yards or component and product warehouses from production to transport
- Inventory management, transport organization, scheduling by augmented operation of complete supply chain in replay, future outlook and optimized mode

Product Status
- Several reference installations in logistics field

Evaluation
- Ease of Implementation
- Addressable Customer Base
- Financial Impact
Augmented Operation – High-bay Warehouse for Coils

Production Schedule – Transparency

Augmented operation of complete supply chain in replay, future outlook and optimized mode
Industrie 4.0/Digitalization was started at SMS group already a decade ago

The process is an evolution with revolutionary impact

Transforming process and business models in the steel industry

Digitalization changes production, maintenance, quality management, R&D and procurement processes first

Enablers are: Big data analytics, embedded systems, digital service platforms, mobile connectivity and cloud computing

Digitalization opens new chances in co-operations between plant suppliers, steel manufacturers and IT start-ups

SMS group is ready - Team up with us in your digitalization road map
Thank you.

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