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

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Vision „Smart Plant 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?
Vision „Industrie 4.0“ - Digitalization

- Trend in manufacturing process to digitize, automate and extend the data exchange
- Customized products under highly flexible and efficient mass production
- Improving automation solutions with self-learning methods and assistance functions for workers or autonomous decisions
- Collaboration of humans with cyber physical systems
Our vision for a Smart Plant in the Steel Industry

**Intelligent, autonomous steel production**

The *intelligent metallurgical plant* optimizes *auto-adaptively* its production process from raw material to finished product as *part of an integrated supply chain* with *physical and data driven models*.

- **Potential orders**
  - Production Planning
  - KPI: Output, Delivery performance, Product in stock, Financials

- **Customer orders**
  - KPI: Plant availability, Minimum inventory, Maintenance stops

- **Plant Condition**
  - KPI: Product tolerances, Material properties, Yield

- **Product Quality**
  - Real-time, cross-linked, unique data source of truth
Smart Plant in Steel Industry

Material property

Production Planning

Productivity

270 965 11 605

HSM Coils weight by month

HSM Coils weight for last 8 weeks

HSM Secondary in % per week of released coils for last 8 weeks

Coil weight by location

Coil weight by release status in % of coils in stock

Order status

Product in stock

Finished products by category

Category
- HR
- HRDP
- CRFH
- CRHP

Quality Yield

Measures
- Secondary [%]
- Scrap [%]

Coil weight assigned to orders

Steel grade groups

- Drawing Steel
- High Strength Low Alloy Steel
- Low Carbon Steel
- Medium Carbon Steel

Production Planning

Order status

Product in stock

Smart Plant in Steel Industry

Material property

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Main benefits:

- Process specific product certificate
- Advanced visual correlation over process chain
- New order assignment
- Stock explorer
- Yield prediction
**Smart Plant in Steel Industry**

**Main benefits:**
- Computerized Maintenance Management System merges
  - Process condition
  - Machine condition
  - Maintenance actions
  - Use of AI

**Plant Condition**

Levels:
- Level 1: Preventive Plant Monitoring
- Level 2
- Level 3

**Smart Maintenance**

- Equipment Info (BoM, drawings, documents etc.)
- Maintenance Strategy
- ERP
- Stock
- CMMS
- Digital Maintenance Action
- Digital Maintenance Documentation

**Market**

- Partners
- Prices
- Availability
- Contract Status
- History
- Remote Service
- …

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**Introduction**

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### Chances for Digital Value Creation in the Steel Industry

#### Supply Chain Management
- Improved predictions of production processes
- Tools for energy patching
- Order specific plant utilization and set-up time optimization
- Simulation tools to optimize production planning
- Outbound logistics

#### Sales
- Active customer management (CRM)
- Improved view of customer demands and current situation in production
- Installation of digital pricing tools
- Digital finger print of product across the production chain (information for final customers)

#### IT
- Seamless digital process chain
- Tailor made data processing and evaluation
- Access to plant information via apps
### Chances for Digital Value Creation in the Steel Industry

**Production**

- Application of big data in process control
- Lifecycle management of tools/components using predictive maintenance
- Integrated digitized entire production chain
- Mobile solutions to increase process transparency
- Real-time tracking of orders or claims
- Mobile, interactive information/data access

**Quality Management**

- Integrated quality management for plants, products, processes and media consumption
- Automated information and adjustments in case of process deviations
- Mobile quality assessment and documentation
- Mobile localization and tracking of products, components or people

**Procurement**

- Warehousing concepts for spare parts
- **Platform Solutions**
  - Paperless tracking of stored goods/parts
  - Automated ordering of goods or parts that are out of stock
- Transparency in the procurement process and logistics
- ERP-catalogue for internal and external ordering processes

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Digitalization changes production, maintenance, quality management and procurement first.
Predictive intelligence metals

Know how

- How to improve continuously?
- What has to be done?
- Recommending Analyses
- Self-learning Analyses
- Self adaptive control
- Intelligent control
- Industrie 4.0
- Indicators
- Industrie 3.0
- Why did it happen?
- Diagnosing Analyses
- Predictions
- Data mining
- Future
- Past
- What happened?
- Descriptive Analyses
- Dashboards & reports
- Necessary steps

Predictive intelligence metals

Industrie 3.0

- Why did it happen?
- Diagnosing Analyses
- Data mining

Industrie 4.0

- How to improve continuously?
- What has to be done?
- Recommending Analyses
- Self-learning Analyses
- Self adaptive control

Past

- Why did it happen?
- Diagnosing Analyses
- Data mining

Future

- What happened?
- Descriptive Analyses
- Dashboards & reports
- Necessary steps
Dillinger Hütte - 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
Lower re-blowing/overblowing rate
Reduced refractory wear
Reduced cooling/heating charge
Increased productivity

Product Status
Solution implemented at two European BOF Converter
Roll-out at further BOF Converters
Embedded Systems for Predictive Maintenance Solutions
**Idea Description**
- Overcome status that components are operating as “black box”
  - No/limited long term operational data are available
  - Life cycle status of components is not known
- Sensors and PLCs independently applied on individual equipment
- Temporary connection to other recording systems

**Value Proposition**
- Intelligent parts independent from existing automation, individually connected and supervised
- Pre-condition for extended warrantee
- Monitoring and incident-based maintenance
- Extended operation time by avoiding periodic maintenance

**Product Status**
- 1st reference in China successfully commissioned
- 2nd reference in Europe successfully commissioned
HD LASr Digitalization of Mold and Segment Shop

**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
- 3\textsuperscript{rd} reference under commissioning
**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
- Twenty 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

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**Evaluation**

- Ease of Implementation
- Addressable Customer Base
- Financial Impact

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Augmented Operation – High-bay Warehouse for Coils

- Relevant product information, equipment and transport devices are visualized with status and movement.
- Augmented product and process information: Temperature, external cooling requirements, next process steps.
- Coil colored according to customer or quality or order number.
- Augmented operation of complete supply chain in replay, future outlook and optimized mode.

Product Management

Process Information

Warehouse Operation

Production Schedule
Augmented Operation – High-bay Warehouse for Coils

Process Information – Temperature

Augmented product and process information: Temperature, external cooling requirements, next process steps
Augmented Operation – High-bay Warehouse for Coils

Warehouse Operation – Transport Initiation

Coil colored according customer or quality or order number
Industrie 4.0/Digitalization was started at SMS group years ago

The process is an evolution rather than a revolution

Transforming process and business models in the steel industry

Digitalization changes production, maintenance, quality management 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 and steel manufacturers

SMS group is open - Team up with us in your digitalization road map
The information provided in this presentation contains a general description of the performance characteristics of the products concerned. The actual products may not always have these characteristics as described and, in particular, these may change as a result of further developments of the products. The provision of this information is not intended to have and will not have legal effect.

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