DANIELI INTELLIGENT MILL
ADDING VALUE TO METALS

2017 SEAISI CONFERENCE AND EXHIBITION
22-25 MAY
SENTOSA, SINGAPORE
1. INTRODUCTION
2. DANIELI INTELLIGENT SYSTEM
3. INTELLIGENT SENSORS
4. RFID
5. Q3 DCMS
6. Q3 DMMS
7. Q3 INTELLIGENCE
8. BUSINESS CASE
9. CONCLUSIONS
INTRODUCTION
By 2020, European industrial companies will invest €140 billion annually in Industrial Internet applications.

In five years, more than 80% of companies will have digitized their value chain.

The Industrial Internet creates better productivity and resource efficiency – 18% increase in efficiency in five years.

The integrated analysis and use of data are the key capabilities for the Industrial Internet.

The Industrial Internet paves the way for new, often disruptive digital business models.

Digitization of the product and service portfolio is the key to sustainable corporate success.
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TOWARDS THE SMART FACTORY: DATA DRIVEN TECHNOLOGIES

Data-driven Services

Data Sources

Platform

Centralized Repository

Big Data IIoT Analytics...

Existing/New Products

Smart Sensors

Plant #1

Plant #N

Qs-Manufacturing
Supply-Chain Process Optimization

Qs-Maintenance
Predictive Maintenance

Qs-Process
Technological Process Optimization

Qs-Energy
Energy & Utility Consumption Optimization

PROACTIVE EFFICIENCY

Data Sources

Plant #1

Plant #N
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Based on Eddy current principle, HiSECTION can measure on line and continuously cross sectional area and weight per meter of rolled stock

> To improve product quality
> To increase plant efficiency
> To reduce production costs
> To enhance plant safety
Hot or cold rolling mills, HiPROFILE provides non-contact on-line profile shape inspection and dimension measurement using laser and high resolution digital image sensors

- Fast 100% inspection and quality control of profile shape (defects) and dimensions
- Faster set-up/adjustment of rolling mill and reduction of scrap and mill down-time
- Down to ±0.5% high accuracy on the linear weight measurement
- Plant efficiency improvement
- Historical Measurement Data Record
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MILL STAND

ASSEMBLY STATIONS
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> High quality service solution for the condition monitoring
> Smart analysis of dedicated sensors (vibration, lubricant condition, machine load, speed, temperature)
> Customization for a wide variety of equipment
> Detection of defects and failures
> Real-time alarms and warning
CASE HISTORY:
BAR MILL STAND GEAR BOX

> Detection of vibrations of the gearbox bearing of the stand #8 of a bar mill
> Vibration amplitudes increased over time until they reached unacceptable amplitude

> Spectra analysis

> Defect highlighting: abnormal wear of the bearing due to eddy currents generated by improper insulation

> Scheduled maintenance and restoration of the proper operating conditions
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> Allows to schedule and keep under control the company maintenance operations

> Helps the operators to scheduling
  > jobs
  > assigning personnel
  > reserving materials
  > recording costs
  > tracking all the information (such as the cause of the problem)
> permits to record all maintenance activities performed and the faults of the equipment

DANIELI MAINTENANCE MANAGEMENT SYSTEM
Can be fully integrated with Level 2 automation, MES (Manufacturing Execution System) and Condition Monitoring System (CMS).

The main features are:
- Plant overview control
- Work order management
- User request
- Fault analysis
- Maintenance planning
- History of works and feedbacks
- Warehouse management
- Components lifetime
- Customized reports
- Teleservice

All data are stored in a database, in order to perform quick process analysis.
> Consists of a technical database of the customer’s plant designed to be uploaded into Q3-DMMS software

> The main contents are
  > equipment Structure hierarchically organized
  > bill of Materials
  > documentation (manuals, datasheets, drawings, diagrams, catalogues, multimedia material)
  > spare parts list (Danieli code, spare description, installed quantity, suggested quantity)
> The maintenance procedures contain all the maintenance activities (checks, inspections, lubrications) as standard job guidelines for mechanical, hydraulic and electric activities.

> The main contents are:
  > duration / frequency
  > plant status
  > safety information
  > activity description
  > residual risks
  > personal protective equipment
  > man power
  > special tools
  > spare parts to use
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QUALITY
Ready to use KPI library with advanced statistical analysis tools to support quality and process optimization

QUANTITY
Merge of multiple and heterogeneous data sources into a unique centralized repository through market standard tools

QUICKNESS
Real-time information and self-service analysis to support decision-making activities
Data generation in modern steel plants is a continuous and automated process; data volume is constantly growing in size.

Heterogeneous data streams coexist; a unified method for handling multiple sources is a plus in terms of rapidity and ease of access to data as well as complex analysis potential, and maintenance by IT personnel.

Having the right information at the right time is crucial to managers and process engineers (stakeholders).

To optimize / increase plant performances.
A data driven methodology for continuous improvement and decision support for stakeholders is highly desirable.

As a Business Intelligence (BI) system, Q3Intelligence addresses the need of a unified approach to analyze production data.

By combining operational and business data streams, it boosts analysis capabilities and ensures support to stakeholders’ decisions in a data driven way.
> Merge of heterogeneous data sources into a centralized repository through market standard tools

> Innovative real-time web-dashboard giving quick access to key process data and KPIs

> Multi-dimensional data model to easily correlate data throughout the entire plant

> Ready to use of advanced statistical tools embedded into excel workbooks
Customer requirements meet
Danieli know-how in the metals industry
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**QUALITY PREDICTION**

**BUSINESS CASE**

**WHY?**

- To **reduce** the amount of products to be tested
- To **reduce** the percentage of out-of-spec final products thanks to a better knowledge of the machine/operation under analysis (e.g.: adjusting the set-up according to results)
- To fine tune process variables in real-time and make products that are in line with specifications

**HOW?**

- Analysis of **historical** production data collected by Q3Intelligence
- Integration of **Machine Learning** resources (services and algorithms) for setting up an advanced and cloud-based analytics framework
- **Ready-to-use prediction service**

**WHAT?**

- **Predict material conformity** (in terms of mechanical properties – e.g. yield strength, tensile strength, elongation, etc.) using production process variables as classifiers
- Use the prediction model to support operational activities
  - **Offline**: product type and process analysis
  - **Online**: fine tuning of the manufacturing process piece by piece
QUALITY PREDICTION

ML Algorithm Training

Machine Learning Module

Data Preparation
Direct Classification
Regression (Boosted)
Prediction

Data Loading
Plant Production Data

ML On-line Prediction

Predictive Module

Input Data
Application
Results
Quality Prediction of the Final Product

Input Variables (Chemicals, Process Variables)

Variables influence on Final Quality
READY-TO-USE PREDICTION SERVICE

ML Model in use
Prediction Service to be used to support
> What-If Analysis
> Estimate Final Product Quality
> Identify Process Variables most influential on Product Quality

- 2 Years of Data
- 11,5k Products
- 5 Production Areas
- 138 Process Variables
- >2B Samples
- 1 Multidisciplinary Team

- 97.5% Predictions in Range
- 10' Training Time
- <1" Response Time
ON LINE QUALITY CONTROL

ROLL WEAR MONITORING

STAND CLOSING

LINEAR WEIGHT BACK TO TARGET
BRAZILIAN ECONOMIC CRISIS

ON LINE QUALITY CONTROL

ROLL WEAR MONITORING

STAND CLOSING

LINEAR WEIGHT BACK TO TARGET
> ON LINE QUALITY CONTROL
> ROLLS WEAR MONITORING
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PRODUCT QUALITY

> Correlation between of the huge amount of data coming from laboratory, HiProfile detected defects, process (i.e. temperatures, heating and cooling patterns, rolling torques, etc.) campaign by campaign

> Continuous improvement of product quality thanks to data-driven set-up/adjustment of the “Intelligent Mill”
WORKSHOP MANAGEMENT

> Redressing activity data (i.e. rolls wear) storage
> Analysis of the operating life of the rolls: correlation between rolls wear and the production data (hours and type of production)
> Statistical analysis of the rolls consumption
> Prediction of the life-time of the rolls
Q3-CMS AND Q3-DDMS

> Improved capability to predict faults at an earlier stage
> Validation of the strategies applied during the ordinary maintenance
DANIELI AUTOMATION

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