Data Driven Manufacturing: Challenges and Opportunities

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OUTLINE

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Industry 4.0

02

The Roles of Data
In Manufacturing 4.0

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Implications on Business and
Manufacturing Operations

04

Project Examples

The Fourth Industrial Revolution Industry 4.0

01

What is industry 4.0?

Industry 3.0 vs. Industry 4.0

Drivers

Advancements in electronics

Commercial uses of computers

Computer-driven transformation

CAD (1960)

Full automatic production line (1969)

Computer Integrated Manufacturing (1990)

Impacts

Higher quality and precision

Higher efficiency

Higher productivity

Drivers

Global value chain

Product customization

Flexible and green manufacturing

Intelligent and adaptive systems

Digital transformation

?

Innovation focuses of industrial revolutions

The industry 4.0 enabling technologies

**Advanced and
Multimodal
Interaction**

Intelligence

**Infrastructure and
Interconnection**

The Roles of Data in Manufacturing

02

Pillars of industry 4.0: from manufacturing (Smart PPR)

Smart Process/ Operation

Smart Product

Smart Resource/
Infrastructure

Data Driven Service

X 4.0

Industry 4.0

Agriculture 4.0

Smart Process/ Operation

Connected farmers, suppliers, market

Smart Resource/ Infrastructure

Automatic watering,
smart transport,
smart warehouse

Smart Product

Self informing crops

Data driven service

How big data can improve manufacturing?

Identify initial patterns (using moving averages, distribution histograms, standard deviations, and clustering) to prioritize data collection and analysis

Identify core determinants of process performance and form an initial hypothesis about root causes of yield drop and variability

Using data visualizations

Using correlation analyses

Using significance testing

Using artificial neural networks

Test initial hypothesis of root causes of yield drop and variability and focus on the most statistically significant factors for further investigation

Model complex processes to quantify the impact of and optimal ranges for the identified parameters

**Implications on
Business and
Manufacturing
Operations**

03

What are the benefits of big data for manufacturing?

Source: University Oxford

Data sources, infrastructure, and analytics

Data Sources

Data Infrastructure

Analytics Methods

Data driven operational optimization

Smart Design

Market and demand analysis

Transaction, demand, user behavior data

Smart Planning and Optimization

Production planning and optimization

Order, capacity, process data

Material tracking

Awareness of material shortages
proactive distribution

BOM, material quantity, distribution data

Process and Condition Monitoring

Facilities and capacity monitoring

Equipment parameters, production schedule, resource loading

Quality Control

Quality tracing and management

Quality criteria, quality test, production process data

Smart Maintenance

Predictive maintenance and energy optimization

Energy consumption, equipment status, fault data

Customer-centric outcomes: data driven services

RALPH LAUREN

Airplane engine +
real time monitoring,
predictive maintenance,
optimization service

Farming machines +
Farm monitoring, social media
<https://myjohndeere.deere.com>

Sport shirt +
Health monitoring, early
warning system

Physical product (local) + digital service (global)

Project Examples

04

Project Ecobalance

ecobalance

- Sensor network to collect data (power consumption, machine states, surrounding factors)
- Power consumption prediction for individual processes and products through machine learning
- Energy optimized production planning and scheduling
- Peak load avoidance

Demand Response (DR)

- The goal of DR is to shift the peak demand (red) to the peak time of availability of renewable energies (yellow).
- The power consumption is shifted from red to green, (green) shows the decrease of energy waste.

Source: Hislop 2016

DR has the potential to access **160 GW** of flexible capacity by **2030**. This reduces energy supply costs by up to **50 billion euros**.

The **industrial sector** produces the **highest real savings in peak demand**

Project Delfine

Project Solution

Cloud

Provider

Dynamic price
module

3D-Simulation

Grünstrom-Index

Forecast and Analytics

Consumer

Production optimization

External data, e.g. weather,
geodata

Semantic Middleware

Edge

Data uplift (e.g. SMGW)

Meters

...

Master data

Data uplift (e.g. SMGW)

Meters

ERP

CAM

Project Smart Data Web

Projects about big data for environment

Project Svalna:
Calculate carbon footprints of individual products and processes

BUSINESS & FINANCIAL NEWS | July 28, 2020

BASF calculates CO₂ footprint of all sales products

• BASF as the first chemical company with transparent emission data for the entire portfolio of approximately 45,000 products

THANK YOU!

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