Industry 3.0 vs. 4.0 - Vision of the new manufacturing world

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The 4th Industrial Revolution

1st revolution
Water Steam and Mechanization
- Hand to machine production
- Factories introduced
- Textile industry an early adopter

2nd revolution
Electricity
- Mass production
- Division of labour
- Automotive industry an early adopter

3rd revolution – Automation and IT
- Increased automation of production
- People empowered to "higher level jobs" – i.e. programming
- Automotive industry use of robotics

4th revolution – Cyberphysical systems
- Mass customisation
- Democratization of manufacturing

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What’s slowing us down?

**What companies are saying:**

“We will never allow third parties to host our data”

“This is just marketing language for technologies we’re already using”

“We’d like to, but don’t have the ability to collect the data or people to make sense of it”

**What are the reasons your company is not using the Cloud and has no plans to do so?**

- Solution looking for a problem
- No clear RoI
- Existing technologies sufficient
- Can’t collect the data
- Real time response needed
- Cybersecurity (theft of data)
- Cybersecurity (impacting production)
- Cost is prohibitive
- Lack of skilled personnel
- Lack of leadership support
Technology (R)evolution

INDUSTRY 3.0  ➔  INDUSTRY 4.0

From data to information

- Sensors (smarter and more connected)
- Connectivity – networking the factory floor from the sensor level to the cloud
  - Big Data – an explosion in the amount of data collected
- User interfaces simplifying technology use (and increasing worker mobility)
- Smarter more dextrous robots able to work “hand-in-hand” with employees
  - Additive manufacturing – new product designs and geometries
Innovation and trends with embedded sensors in automation and IPC

Sensor embedded in more equipment for predictive maintenance. Enabling new business models

- ABB’s smart sensor,
  - Makes vibration sensing affordable for lighter industrial assets
  - Target low voltage motors (low cost)
  - 150€ (estimated 50€ in volume)
  - Cloud based analytics

- Smart bearings with embedded sensors
  - Introduced or in development e.g. from SKF, FAG, NTN...
  - Speed, vibration, temperature, load, angle...
  - Enable to change business model: selling service and eventually uptime rather than just mechanical hardware
  - Secure closer relationship with customer

Wireless vibration sensor module for 50€ (photo IHS, Hannover Fair)

FAG VarioSense Bearing with speed, load, temp and vibration sensing
Change in the automation hierarchy - traditional

Photoelectric

Resolver

Inductive

Capacitive

OPC UA / MQTT solutions enable secure communication from factories to an off-site cloud.

Programmable logic controllers (PLCs)

Fieldbus/Ethernet protocols allow networking and real-time distributed control within hierarchies.

Cloud

ERP

MES

SCADA systems

Control systems - PLCs, DCS and IPC

Sensors, actuators, hardware
Change in the automation hierarchy – potential change

ERP
MES
SCADA systems
Control systems – PLCs, DCS and IPC
Sensors, actuators, hardware

Cloud

Programmable logic controllers (PLCs)

Gateways enable communications to a remote network like the cloud (MCU)

IO-link gateway

IO-link protocol supports 2-way communication between sensors and networks

Vibration sensor

Encoder

Commutator + temperature sensor

Microcontrollers (MCUs)

Motor

Sensors can be stand-alone and then networked to motors; or embedded into motors from the outset

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New vendors are key to IIoT

**Example technologies and services**
- Micro controllers
- Connectors
- Wireless ICs
- Sensors
- PLCs
- Operator terminals
- Remote I/O
- IPC’s
- Motion control products
- Processing machines
- Packaging machines
- Material Handling
- Robotics
- Servers
- Routers
- Switches
- Computers
- Networking
- Industrial protocols
- 5G
- LoRaWAN
- IP protection
- Equipment downtime prevention
- Regulation compliance
- Worker safety
- Cloud
- Connectivity management
- Data management
- Device management
- Application enablement
- PLM
- MES/MOM
- ERP
- SCADA
- Technology expertise
- IT and OT collaboration
- Change management
- Remote Monitoring
- Predictive maintenance
- Plant visualisation
- Design and simulations tools
- Oracle
- Dassault
- PTC
- SAP
- Honeywell
- Accenture
- Capgemini
- Maverick Technologies
- PwC
- Tata
- M+W Automation
- IBM
- GE
- Siemens
- BASF

**Example Stakeholders**
- Intel
- Qualcomm
- Infineon
- Toshiba
- NXP
- Balluff
- SICK
- GE
- Rockwell
- Siemens
- Schneider Electric
- Emerson
- Mitsubishi Electric
- Bosch
- Packaging Tech
- ProMach
- ITW
- Tetra Laval
- Krones
- FANUC
- KUKA
- Cisco
- Belden
- Dell
- HP
- Vodafone
- AT&T
- Huawei
- Ericsson
- Orange
- Symantec
- McAfee
- Lockheed-Martin
- Microsoft
- IBM
- SAP
- GE
- Siemens
- Bosch
- Coca-Cola
- BMW
- Foxconn
- Samsung
- Shell
- BASF
How business is changed? Internet of Things Evolution

- IT – OT convergence remains a challenge
- Internal preference for team leading IoT projects is evenly split between engineering and IT teams
- C-Suite leads only 10% of respondents projects
- Centrality of automation products influences decision making process
What can we do with this?

- Asset related analytics provide low hanging fruit
- IIoT vendors are entering the market with differing strategies
- Almost half of companies see Improved throughput and productivity OR Reduced downtime / production failure as the main benefits.

Which of the following applications do you believe will benefit most from your organizations use of the Cloud for IoT related applications:

- Asset tracking
- Condition monitoring
- Predictive maintenance
- Maintenance planning
- Demand monitoring
- Design, Prototyping and simulation
- Energy management
- Plant / factory control
- Plant / factory visualization
- Remote servicing / training
- Resource planning
- Other (please specify)
Benefits across the lifecycle

**Design**
- **Harley-Davidson**
  Reduced model New Product Introduction (NPI) from more than a year to 1.5 weeks
- **Maserati**
  reduced number of prototypes, and time to market resulting in 30% less development time.

**Operations**
- **Petroflow Energy Corp.**
  Site power consumption reduced by 43%
- **Marathon Petroleum Company**
  Alarm rate reduced by approx. 90%
- **Husky Injection Moulding**
  productivity and cycle time gained from 3% to 12%

**Maintenance**
- **CNH Industrial**
  average maintenance time reduced by 50%
- **Fanuc**
  Saved US$2M from reduced downtime
- **Nova Chemicals**
  reactive emergency work reduced by 47% and time spent on proactive, preventative maintenance has increased by 61%

**Supply Chain**
- **Sandvik Coromant**
  Monitors existence of any bottlenecks in the overall supply chain
- **Shanghai CHILO Press Company**
  Inventory error rate reduced from 50% to 4% within 6 months. Inventory control converted US$95k loss to a US$158k profit
IoT Servitisation - the new business model

“Industrial companies are in the information business whether they want to be or not.” – Jeff Immelt GE

Shift of business from selling hardware to selling service

- New services models introducing new revenue streams and closer ties with customers
- Shift from CapEx to OpEx spend
- Challenges on revenue sharing across a partner ecosystem
Summary

• It’s coming (but not tomorrow)
• Technology will evolve – applications and business models will be revolutionised
• Partnership between IT and OT will be necessary (internally and externally)
• “People” are the most significant inhibitor to growth

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