Digitalization
The Fourth Industrial Revolution!? 

Four Exciting Gadgets and One Must Go…
Technology is Fun!
What are We Doing at ABB?

We make sure that “two holes in the wall” are not just “two holes in the wall”, but rather a secure source of environmentally friendly electricity...

...and that the factories of the world can produce what they want in an efficient, safe and sustainable way!

Power and Productivity for a better World!

Fourth revolution?
Industrial Revolutions

Industry 1.0 – 18th century
Steam engine

Industry 2.0 – 20th century
Mass production, electrification, assembly lines

Industry 3.0 – 1970’ies
Microprocessors and software

Industry 4.0 – today and tomorrow
Industrial Digitalization

ABB has for many years offered connected products

Many International Initiatives
"Re-industrialization or new industrialization"

- Industrie 4.0: German initiative initiated by the German government, 500 MEUR over three years.
- Smart Manufacturing Leadership Coalition
- Advanced Manufacturing program
- Intelligent Manufacturing program
- Smart Industry
- Made Different
- Made
- EFFRA
- ...
WHAT IS DIGITALIZATION?
TECHNICAL DRIVERS

Digitalization
Has Anything Happened the Last 10 Years?

- Music
- Watch TV & movies
- Book travel
- Book accommodation
- Taxi
- Books
- Clothes
- Food
- Education
- Maps
- Banking
- Knowledge
- Betting
- Mail
- …
Industrial Digitalization
Scope?

- Product offering & business models
- Distribution
- Market channels
- Customer contacts
- Product development & innovation
- Production & maintenance
- Collaboration with sub-suppliers
- Integration in the energy system

Digitalization
Drivers

- Internet of Things
- Wireless Communication
- Big Data Analytics
- Visualization
- Cloud
- Mobility
- Digital Natives
- Moore's Law
- Price
- Collaborative Robots
"The Memory Revolution"

Bring all your information anywhere. Today available with up to 256 GB, i.e. appr. 192,000 diskettes!!

Source: www.kingston.com

"The Memory Revolution"

1984

$3398
10MB
THE HARD DISK
YOU'VE BEEN WAITING FOR

2016

4 TByte, 120 USD!!
(corresponding to 2,780,000 diskettes!)

Sources: www.lacie.com, www.gizmodo.com
Internet of Things (IoT) – Cyber Physical Systems

Many with sensors

“The Cloud”

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May 6, 2016 | Slide 14

Things?
Things? – Estimote Sticker

- 32bit ARM computer with 256 kB Flash
- Temperature sensor (-20 - +50 degrees C)
- Accelerometer
- Bluetooth Low Energy
  - 70 meters
  - Range & Proximity
- 1 year battery life
- iBeacon compatible

Pack of 10 – 99 USD
Internet

IPv6:
- 32 -> 128 bit address field
- $3,4 \times 10^{38}$ addresses
- 57 million addresses per gram of the mass of Earth!!

“The Cloud” – What?

- Access to unlimited storage and processing power
- Scalability – "Pay per use"
- Investment -> Operation cost
- Ultimate IT-outsourcing
- Access from anywhere & mobility
- Cyber Security!?
- Availability!?
- Access performance!?
Storage of Data in the Cloud

<table>
<thead>
<tr>
<th>Storage Provider</th>
<th>Storage Price ($/GB/Month)</th>
<th>Cloud Store Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backblaze</td>
<td>$0.005</td>
<td>$0.005</td>
</tr>
<tr>
<td>Amazon S3</td>
<td>$0.002+</td>
<td>Free</td>
</tr>
<tr>
<td>Microsoft Azure</td>
<td>$0.032+</td>
<td>Free</td>
</tr>
<tr>
<td>Google Cloud</td>
<td>$0.030+</td>
<td>Free</td>
</tr>
<tr>
<td>Verizon</td>
<td>$0.140</td>
<td>$0.06+</td>
</tr>
<tr>
<td>RackSpace</td>
<td>$0.075+</td>
<td>Free</td>
</tr>
<tr>
<td>CenturyLink</td>
<td>$0.150</td>
<td>$0.06+</td>
</tr>
</tbody>
</table>

Big Data Analytics – What is it?

- There is basically unlimited amount of data available!
- Data and information is worthless!
- You need knowledge that you can act upon – Decision support
- Then you need:
  - Data storage
  - Algorithms (statistics, machine learning, AI etc.)
  - Visualization
  - … and domain knowledge!
3D Visualization – Computer Gaming

Industrial 3D Visualization with Gaming Technology
3D Visualization of Windfarms
Mobile Devices
Very Powerful Computers!

- Processing power
- Graphics
- Sensors
- Communication
- Data speed
- Storage
- Accessibility
- Apps & AppStore
- …

Where is the Development?

Consumer Products

- Computer Gaming
- eHealth
- Mobile phones
- Social media
- Media/entertainment
- eCommerce
- Cars
What is Key for Industrial Products?

- **Availability**: operation 365/24/7
- **Real-time behavior**: “nothing” must disturb the process
- **Predictability**: system must behave as expected
- **Tough Environments**: moisture, electro-magnetic disturbances, temperatures etc.
- **Safety**: personnel and equipment safety highest priority
- **Security**: Protection against illegal entry and sabotage ever more important
- **Longevity**: extend, upgrade, modernize etc. during a very long time period (5-30 years)

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Five Key Technologies for Digitalization

- Mobility
- Analytics
- Cloud Computing
- Data storage
- Internet of Things
Five Key Technologies for Digitalization

What the Customer Really Needs

- Higher productivity & greater flexibility
- Improved resource and asset utilization
- Lower costs and simpler processes
- Enhanced safety and security
- Improved decision support

Analytics

Cloud Computing

Collaborative Robotics

© ABB Group
Collaborative Robots
YuMi – Worlds First Safe Industrial Robot

The Fourth Industrial (r)evolution
IoTSP
The Mobile Phone - What Happened?

Apple's vision

"The future of phones are Apps"

ABB Vision for Industrial Equipment

Our Vision?

“The future of Industrial Equipment is Apps!”
The "Conventional" Digital Twin Concept

- Represent every Thing with a replica in the cloud
- Connect and empower it with advanced services
- One App per thing / family of things

ABB’s Aspect Object Technology
The ABB Digital Twin Concept - Today

Process Object (Thing) functionality:
- Faceplates, Graphic Symbols
- Alarm management
- Trend, History
- Drawings
- Instructions
- Video
- Asset data
- ...

ABB’s Aspect Object Technology
The ABB Digital Twin Concept - Today
Aspect Objects
Internet of Things, Services & People

- Auto configuration
- Optimization
- Usage Analysis
- Speech recognition
- Mail
- Chat
- Spare parts
- Purchasing
- Machine learning
Hi Tom,
Can’t start P112 pump!

Why not?

I have talked to the Level indicator LT112 that indicates empty. Agitator AG110 says that the motor still uses normal torque. We have agreed that the level indicator probably is broken.

I agree.
Ignore Level indicator and continue draining until Agitator torque is reduced to zero.

By the way, pls order a new level indicator.

Drain system DS1
Tom, operator on duty

Sample chat with a drain system
IoTSP: Robotics
Remote Service Center

Things
- Intelligent and connected robots
- Data sent to central servers for backup, reporting, diagnostics, and benchmarking

Services
- Central service center can remotely supervise customer's robots 24/7/365
- Analysis to optimize robot operation and predict maintenance needs

People
- The customer can access operation and maintenance information from e.g. mobiles or tablets – "MyRobot"
- The information is available everywhere and anytime

Industry 4.0 in action – since almost 10 years!

IoTSP – Motor Diagnostics
Mobile Measurements

Challenge:
- Cost
- Old equipment

ABB solution:
- Use mobile with built-in sensors for diagnostics
  - Accelerometer for vibrations
  - Compass for magnetic field
  - Microphone for noise
- Quick health check to decide on further actions:
  - Store fingerprints and identify trends
  - More thorough analysis
  - Further action from service specialist
ABB’s New Smart Sensor for LV Motors

- Pre-mounted or retrofitted
- Low cost
- Low power
- Wireless
- Integrated sensors to monitor:
  - Vibration
  - Temperature
  - Energy consumption
- Cloud based services

IoTSP
Trim Optimization

4 MW less propulsion power.
Savings of $1 million per year.
IoTSP - EMMA
Trim – Not Optimal

IoTSP - EMMA
Trim – Almost Perfect
WHAT ELSE IS IMPORTANT?

Wearables – Computers You Wear!
Smart Clothes & Wearable Technology

The large gap between users and developers often results in products that are difficult to use.

By connecting users and developers we create conditions for products that are easy, effective and fun to use!

Good User Interaction
Involve the Users in the Product Development!
Let's Take a Closer Look at Eric, a Young Operator
Eric = Efficient?

- Bored
- No self-confidence
- Not have the same background as his older colleagues
- Totally dependent upon the experienced operators
- Considered uninterested (and maybe a bit stupid) by his colleagues
- He feels like he is at the wrong place!

Hopeless situation?
Let's Take a Closer Look at Eric

Eric = Efficient!

Eric when playing StarCraft:
- extremely self-confident
- has more than 200 APM
- gets at least 5 adrenalin kicks per minute
- feels self-realization and being part of a large community
- is fantastic at multi-tasking
- continuously learns new things
- gets immediate feedback

Gamification!!!
Future Workforce…

Operator?  Maintenance engineer?  Plant manager?

Robot programmer?  Production planners?

Augmented Reality
Google – Project Glass

Microsoft HoloLens
Microsoft HoloLens

3D Printers – Desktop Production

- Today plastics
- Today single material, single color
- Today slow
- Today expensive
3D Printers – “Digital Fabs”
Robot Spare Part!

Social media - Some Facts 2015

- Facebook
  - 1.590.000.000 monthly active users
  - >50% of North American population
  - 150.000.000 new users
  - 4.750.000.000 shares/day
  - 4.500.000.000 likes/day

- SMS
  - 5.600.000.000.000 SMS
  - 260.000 per second

- YouTube
  - 6.000.000.000 hours / month
  - 400 new hours / minute
  - Gangnam Style has 2,555,840,085 viewings

- Twitter
  - 500.000.000 tweets/day
  - 320.000.000 monthly active users

- Instagram
  - 150.000.000 new users
  - 80.000.000 photos/day
  - 40.500 likes/second

- Email
  - 72.000.000.000.000 emails
  - 55% opened on mobile
  - 45% spam
Puchi Puchi!!??

Four Exciting Gadgets - One does not Belong...
Summary!
Industrial Requirements

- Reliability
- Real time behavior
- Predictability
- Tough environment
- Safety
- Security
- Longevity
Summary!
The User in Focus

Summary!
Rapid Technology Development

Cloud  Big data  Optimization
Industrie 4.0  Internet of Things  Multi-core
Gamification  Sensors  Augmented reality
Mobile devices  Modeling & simulation  Remote control
Collaboration  Cyber Physical Systems  Power electronics
Service robots  NUI  Virtualization
Social media  New materials  3D-printers
Summary!
The Fourth Industrial (r)evolution – Internet of…

What the Customer Really Needs

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Internet of Things

Mobility

Big Data Analytics

Cloud Computing

Data Storage
Summary!
Digital Transformation of the Enterprise

- Product offering & business models
- Distribution
- Market channels
- Customer contacts
- Product development
- Production & maintenance
- Collaboration with sub-suppliers
- Integration in the energy system

Summary!
So, What To Do Now?

- Get knowledge!
- Be curious!
- Test!
- Think about what could I do with this new technology!
- Focus on value creation and business models!

- Collaborate with a stable and forward-looking supplier!
Summary!
Technology is Fun - And Universal!

Power and productivity for a better world™