Industrial AI for Autonomous Industries @ ABB
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Transformation in markets: energy and fourth industrial revolutions

The Energy Revolution

The Fourth Industrial Revolution

Utilities  |  Industry  |  Transport & Infrastructure

Source: Economist, WEF
Industrial markets primed to adopt digital technologies
Computing + connectivity + cloud + analytics set to unlock value

Digital S-Curve

- Agriculture
- Food & Beverage
- Mining & Metals
- Healthcare
- Buildings
- Oil & Gas
- Marine
- Rail & Road Logistics
- Automotive/Discrete
- Chemicals
- Utilities
- Retail
- Finance & Insurance
- Media
- ICT
- Other industries
- ABB end-market

Note: relative size of industry for advanced economies
Source: ABB analysis
What does it take to win in digital?

Mastering the control room

Service action \(\rightarrow\) Maintenance \(\rightarrow\) Plant / equip. health

Set points \(\rightarrow\) Operation \(\rightarrow\) Operational data

Control signals \(\rightarrow\) Control \(\rightarrow\) Measurements

From physical to digital differentiation
What does it take to win in digital?
Mastering the control room

- Service action
- Set points
- Control signals

Analyze → Maintenance
Sense → Operation
Control → Act

Plant / equip. health
Operational data
Measurements
Sadara: largest petrochemical plant

150,000 connected devices
Garpenberg: world’s most productive zinc mine

ABB Ability™ Mine Optimize delivers energy savings and improved uptime
Lefdal: greenest data center

ABB Ability™ power solutions enable reliable power & cooling
How ABB Ability™ solutions deliver value
Digitally connected products and services providing expertise
How ABB Ability™ solutions deliver value

Digitally connected products and services providing expertise
Collaboration in the data driven ecosystem

ABB Ability™ in action

- Improved operational effectiveness
- Fast and efficient resolution of issues
ABB Ability™ Collaborative Operations™
700 vessels connected, 24/7

Connecting vessels and shore operations with our experts

Vessel
Data capture and real-time optimization

ABB Operations Center
Performance and condition analysis

Customer Operations Center
Fleet management
ABB Ability™ Collaborative Operations™

ABB Operations Centers
24/7 globally

Monitoring & Optimization
Energy efficiency and safety

Maintenance & Condition Monitoring
Availability

Our way of working. Today.
Operation monitoring and optimization with Octopus

**ABB Ability™ Collaborative Operations™**

**Speed and route optimization**
- 2-5% saving opportunity

**Motion forecasting**
- Zero damage to cargo

**Trim optimization**
- 2-5% saving opportunity

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Digital benefits also goes beyond ABB equipment
ABB Ability™ Collaborative Operations™

Maintenance and condition monitoring with RDS

Asset health and dashboards

Avoid down-time

Remote diagnostics & Condition-based maintenance

Extend mechanical bearing lifetime from 3 to 5 years

Maximizing equipment up-time
Automated systems move towards autonomous

- Steady state control → Normal operation – Start, transients, stop → Complete plant lifecycle
Moving towards autonomous industries

AI is the enabling technology
Properties of Industrial AI

Compared to mainstream AI – AI for consumer applications

Perceive despite sparse information

Understand the small unknown

Solve without violating safety

Industrial AI requires approaches that extend the capabilities of mainstream AI
Complexity of the industrial reality
Life isn't playing a game

Well defined rules and limited states in games

Unlimited states in reality

Moving from a closed world to reality requires Industrial AI

Hybrid algorithms
Use what you know

Removing the known from the data reveals the unknown
Industrial AI addressing the complexity in industrial reality
Combining domain knowledge with data

Know (foresight)
- Domain knowledge
  - First principles models and simulation
    - Described, but not yet observed
  - Safety, control and optimization
    - Engineered well-defined solutions

Observe (hindsight)
- Data science
  - Data driven models
    - Observed, but not a priori described
- Industrial AI
  - Complex scenarios

Combined approach
- Build on what is known
- Safely avoid known dangers
- Explore the unknown through data analysis and simulation to increase flexibility

Industrial AI needs a combination of domain and data expertise to be successful
Operator environments: Increasing amount of data presented

Complexity beyond human comprehension

~1910  ~1990  ~Today  Future

Decision making: human operator – Data based support: artificial intelligence
Steering towards autonomous ships
Revolutionizing transport with AI

From...

To...

Changing the view of the captain
Manipulate and move
Autonomous robots designed for target segments

“Data center sheriff”

“Motor crawler”

“Transformer diver”

“Plant helicopter”
Moving towards autonomous industries

Increasing the level of autonomy

**Level 0**
- Humans: in complete control

**Level 1**
- Humans: specifying set-points
- Assistance with or control of subtasks

**Level 2**
- Humans: specifying intent
- Occasional autonomy

Prerequisite: legal, ethical aspects. Automation system monitors the environment.

**Level 3**
- Humans: confirm / fallback
- Limited autonomy and alerts

**Level 4**
- Humans: supervise
- System mostly in full control

**Level 5**
- Humans: absent
- Autonomous operation

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Conclusions

AI helps expanding automation systems’ capabilities towards handling more unplanned situations

Seamless interaction between deterministic, reliable control algorithms and AI solutions are key to success

The availability of complete, correct, and consistent data to train AI algorithms is essential

The interaction between humans and AI systems lead to the creation of the augmented expert, combining best of both worlds

The key focus shall always be the customer’s challenge, AI is just one of the tools to be applied
ABB is building a bridge to the future