POWER GENERATION & WATER

ABB Ability™ Collaborative Operations

Together, we drive progress

ABB Ability™ Collaborative Operations delivers digital services efficiently to ABB customers through:

People: It connects the customer's staff with ABB technology and process experts, enabling them to work together and improve plant performance.

Places: It links the customer's plants and sites through a high-speed, cyber-secure connection to the ABB Collaborative Operations Center.

Platform: It combines ABB Ability™ and the Microsoft Azure cloud into a powerful technology platform to ensure the plant or fleet is operating optimally within regulatory, load and process requirements.

Profitability: It helps customers optimize operations, increase productivity and reduce costs, releasing more money to the bottom line.

The challenge:
Constant change and increasing complexity

The power industry is in a state of continuous change and rising complexity.

For more than 25 years utilities and energy companies have faced more and bigger challenges than perhaps any other industry.

Deregulation and power trading, competition and price volatility, compliance with emissions control, the influx of variable renewables into the energy mix, flexible production instead of constant operation at base load, a generation of highly skilled people entering retirement, and the threat to plants and data of cyberattack - are among the most crucial.

So, what is the solution to this stream of disruptions to traditional business models? And how can companies best manage risk, minimize costs and optimize plant and fleet performance?

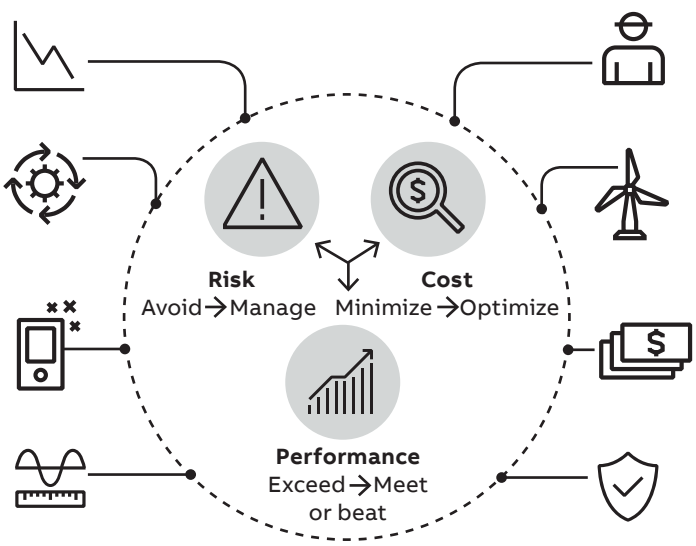
Current challenges and changes facing utilities

Flattening demand
- Between 1975 and 2005, generation to customer electricity demand grew by a 2.5% CAGR; since 2005, demand has grown by 0.05% in the US[1]

Reliability
- There is increasing pressure to continually improve reliability and customer satisfaction

Need for improved customer engagement
- Customer expectations of engagement are changing
- 25 billion devices (excluding smartphones, tablets and computers) will be be connected to the IoT by 2020[3]

Business model disruption
- By 2020 non-utility players will seize 20% of the energy retail market
- 2.5 GW of electricity will be generated by 20% of Fortune 500 companies, who will wholesale their distributed energy resource excess power through utility-independent subsidiaries[4]



Transitioning workforce
- 40% of the workforce at US electric and gas utilities will be eligible for retirement in the next five years[6]

Renewables penetration
- Global renewables capacity has increased by 8-10% y-o-y since 2010, and the trend will continue with more than 150GW added annually (2/3 of all capacity addition)

Spending justification
- Continued revenue challenges and regulatory inspection will drive Totex focus and cost constraints

Cyber security
- Attacks on critical infrastructure are increasing in terms of regularity and sophistication
- Through 2018, 50% of IoT device manufacturers will not be able to address threats due to weak authentication practices[7]

[1] Harris Williams & Co; [2] ARC Advisory Group, November 2014;[3] Gartner. Predicts 2016: Unexpected Implications Arising From the Internet of Things. December 2015;
[4] IDC FutureScape: Worldwide Utilities 2017 Predictions; [5] IDC Energy IDC FutureScape: Worldwide Digital Transformation 2017 Predictions; [6] APPA; [7] Gartner. Predicts 2016: Unexpected Implications Arising From the Internet of Things. December 2015 IDC Innovators 2017

Power BI
The new era of e-mobility has arrived.
ABB

The solution:
Digitalization and Collaborative Operations

Digitalization is driving growth
Digitalization enables utilities and energy companies to overcome disruption and capitalize on the opportunities that digital creates for greater efficiency, higher productivity and increased profitability.

Research shows that power companies that embrace digitalization gain more than 10 percent in productivity, maintenance and reliability improvements, compared to only 1-2 percent for companies that neglect digitalization.

How to unlock the power of digitalization
To create value for power generation customers requires a large installed base and process expertise. It is not enough simply to attach a sensor to a machine and transmit the data to the cloud. The value lies in transforming the data into actionable information that helps customers derive maximum value from digitalizing their assets.

ABB has the installed base, the expertise and the digital platform - ABB Ability™ - to unlock the potential of digitalization and deliver it in the form of bottom-line benefits.

The digital brain - and the enabling technology in the digitalized power plant or water facility - is the distributed control system. It is here where the data is collected, aggregated, analyzed and turned into usable information for the right person at the right time.

Digitalization and the DCS
Thanks to our strong industrial focus, ABB has the world's largest installed base of digitally enabled and connected devices:
- 70 million digitally enabled devices
- 70,000 digital control systems
- 6,000 enterprise-level software solutions
- 50 cloud-based services and analytics

We are also the world's leading supplier of distributed control systems (DCS), both in general and in industries like oil and gas, pulp and paper, and mining and metals, according to industry analysts, ARC Advisory.

Our total plant automation platform, ABB Ability™ Symphony® Plus, is the world's leading DCS for the power generation industry.

This combination of innovation and leadership in digitalization and industrial control systems led Frost & Sullivan to name ABB its 2017 Global DCS Company of the Year:
"Continuing its decades of innovation history, ABB is a pioneering leader in the DCS market and leads the digitalization of the energy industry."
Frost & Sullivan, 2017

Collaborative Operations
Turns big data into actionable information

In this new era of digitalization, close collaboration between partners is vital to reap the full benefits that big data and analytics offer.

The approach that enables digital collaboration is ABB Ability™ Collaborative Operations - a remote operations and maintenance model that helps power generators harness the potential of digitalization.

Through a high-speed, cyber-secure connection to the plant's distributed control system, the center continuously monitors key performance indicators (KPIs) across a comprehensive suite of applications to ensure that each plant is operating within regulatory, load, environmental and cyber security requirements, automatically notifying the customer if a KPI is underperforming or a reference limit is broken.

Easy-to-use dashboards
The center continuously retrieves and analyzes plant performance data, turning it into easy-to-use dashboards that make the data actionable for plant personnel and management.

The suite of applications monitored includes plant process performance analysis, load scheduling profile monitoring, continuous emissions analysis, primary control check unit supervision, control system loop monitoring and tuning, cyber security assessment and management, and many others.

When responding to queries, the center provides immediate access to ABB experts with deep knowledge of plant processes, systems and equipment. Each query is ticketed, tracked and closed in a case management system to ensure transparency and efficiency.

Collaborative Operations
connects ABB with the customer's HQ and production facilities, turning plant and fleet data into actionable information

We combine:
- Process engineering knowledge
- Industry-specific application knowledge
- and deep field service experience

with digital technologies to create remote-enabled interactive environments that provide:

- Incident identification
- Predictive notification of imminent events, and
- Detailed data analytics

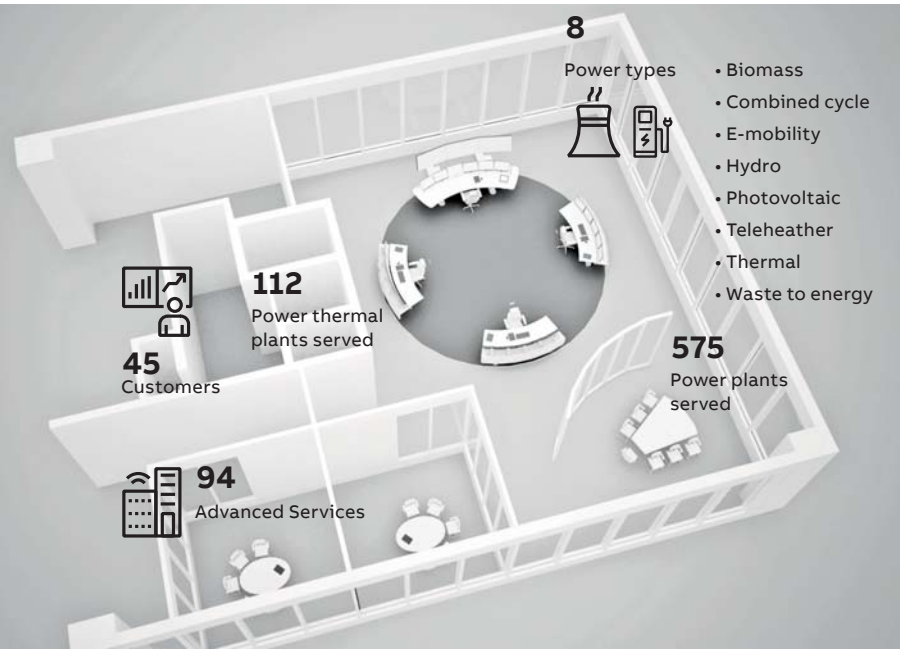
Center of competence
Uniquely, everything is housed in one center of competence – remote monitoring, ABB process and technology expertise, data analysis, dashboard creation and case management – and operated through a single cyber-secure platform.

ABB operates three Collaborative Operations Centers for power generation and water: in Genoa, Italy; Singapore; and Mannheim, Germany. They specialize in thermal power plants, hydropower plants, waste-to-energy plants, biomass and renewables, and water treatment and desalination plants.

It is available both for ABB and non-ABB distributed control systems and serves customers worldwide.

Connected to 687 plants worldwide

Collaborative Operations Center



Protecting your data and intellectual property
Protecting the customer's data and intellectual property (IP) is vital. We are as concerned about keeping that data and IP safe and secure as we are about our own.

To this end we have an IP position to ensure a code of conduct is followed by our organization to protect customers' intellectual property.

We have also issued a data manifesto to bring transparency to data collection and use in the Internet of Things. It is our firm belief that customers own their data and that they should know what ABB is doing with it. Through industry organizations we are encouraging all operational technology and information technology companies to do the same.

We secure your systems	You own your data	You own your IP
• Secure operations • Threat detection • Secure communications • Secure updates • Secure boot	• Identity • Measurement data • You know what we do with your data • We only share with your consent	• No loss of intellectual property when using ABB Ability™ solutions
ABB cyber security standards	**ABB IoT Data Manifesto**	**ABB intellectual property position**

Comprehensive, collaborative, competitive
23 ways to improve operations

Collaborative Operations offers a comprehensive suite of 23 advanced digital services to raise performance and profitability for power generation companies.

They cover almost everything from plant, fleet and equipment optimization to improving operator effectiveness, implementing advanced emissions control and enhancing safety throughout the organization.

Collaborative Operations

Asset Health

- Cycling Impact (thermal gradients causing stress to thick bodies)
- Boiler and turbine stress evaluator

Safety management

- SafetyApp

Cyber security

- Continuous monitoring of potential threats
- Regular reporting of installation status
- Installation of patches and virus scan updates

Alarm management

- Alarm rationalization

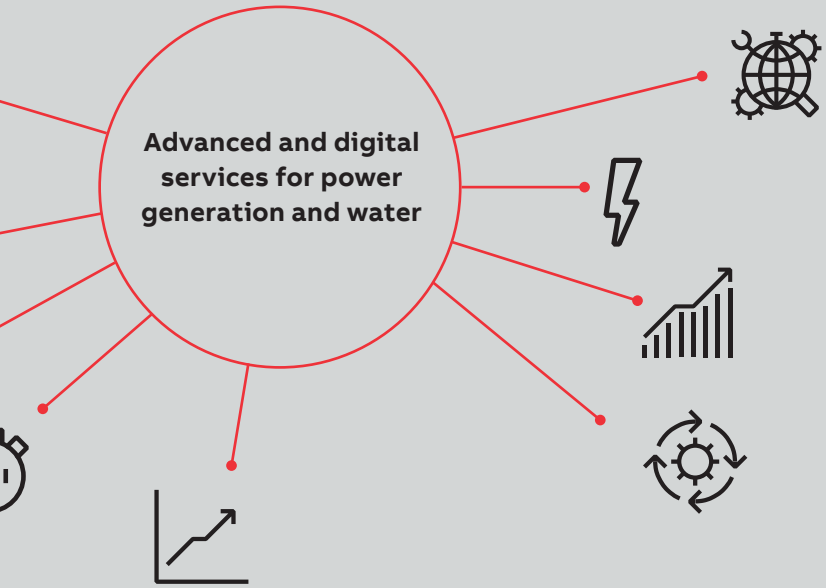
Performance optimization

- Loop tuning optimization
- Advanced controls
  - Strategic control optimizes power trading in an extensive market analysis
  - Tactical control—multi-variable process control for higher performance
- Advanced applicatio
  - Flexibilization solu
  - Boiler start-up op
  - Combustion optin
  - Advanced coordin control valve
  - HPP power maxim

A pipeline of new digital technologies
ABB is continually enhancing its collaborative operations services, adding new digital technologies to extend our offering and improve plant and fleet operations.

Reducing troubleshooting from hours to minutes
Microsoft HoloLens allows plant operators and service engineers to collaborate with ABB experts in troubleshooting a problem using augmented reality.

This eliminates the need to call out an ABB service technician, which often involves travel and overnight costs, and solves the problem typically within minutes.



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ator of fuel flow and turbine

ization

- Advanced emissions control
  - Continuous emission monitoring systems
  - NO_x and SO_x abatement

Operation and technical support

- High-performance HMI

Energy optimization

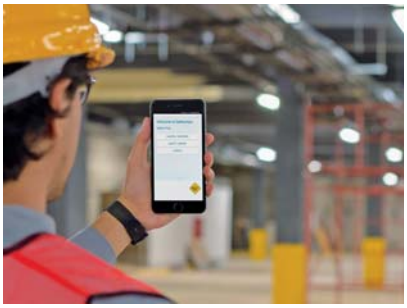
- Energy efficiency

Condition monitoring

- Enabling CB and predictive maintenance
- Vibration monitoring
- Sensor diagnostic/ Failure identification

Predictive maintenance

- Applicable to: FFPP, CCPP, cogeneration, GT open cycle, hydro, thermal-solar, power and desalination, waste-to-heat plants
- Applicable to fleet
- Applicable to 3° party DCS
  - Performance monitoring: actual efficiency vs. expected
  - Sootblowing advisory
  - Control system health check
  - Alarm Management



Digital app simplifies safety
ABB's award-winning SafetyApp turns reporting, tracking and managing safety hazards into a simple procedure that is fast and easy to use.

Since its introduction in 2014, the app has reduced, for ABB, the number of serious incidents in one region (Europe) by 50 percent.

Helping our customers to reduce costs and raise revenue

Many companies have benefited from working closely with ABB Ability™ Collaborative Operations for power generation.

Here are three examples that demonstrate the breadth of services on offer and the savings and performance enhancements achieved.

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Energy costs reduced by $350,000 per year
Analysis of feed water pump data at a 350 MW combined cycle power plant in Europe showed that there was an opportunity to reduce the pump's power consumption and carbon dioxide emissions by equipping it with a variable speed drive.

Instead of the pump running at the same fixed speed, regardless of flow, the drive would automatically adjust the pump speed to match the intensity of feed water flow.

Once installed, the drive reduced pump energy consumption by 37 percent, equivalent to a saving of $350,000 per year, and lowered plant carbon dioxide emissions by 2,200 tons annually.

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20% reduction in maintenance work
As part of a collaborative operations project with a global energy company, ABB installed a predictive maintenance solution in a small 5.5 MW hydropower plant in Europe, whose three turbines were built in 1927. The solution's initial purpose was to monitor plant health for a year to determine the difference between actual and potential performance.

During this time, the solution detected cavitation in a pump impeller, which was unknown to staff and detectable only by monitoring. Having discovered the fault, the solution performed a root cause analysis and forecast the time left before the condition became critical. This enabled the plant to adjust its maintenance schedule and repair the fault at the optimal moment.

Overall, the solution improved the baseline performance of plant equipment, made maintenance more efficient and reduced maintenance working hours by 20 percent.

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Recovering 10 MW of turbine output
A gas turbine with a rated output of 250 MW at a combined cycle plant in Europe was underperforming by 10 MW.

Working collaboratively with the customer, ABB installed its ABB Ability™ Symphony® Plus turbine monitoring module to monitor performance and diagnose the reason for the 10 MW loss in output.

The solution pinpointed the source of the loss to a compressor. After repair, the turbine regained its maximum output of 250 MW, an improvement worth about $1.5 million annually in revenues.

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A final word from Frost & Sullivan
"ABB equips industrial customers with the digital technology and cloud platform to empower every person, team, and business system within an organization to glean new insights and drive smarter, faster and simpler decision-making - thereby helping every customer seize new growth opportunities."

Frost & Sullivan on naming ABB its 2017 Global DCS Company of the Year

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About ABB Power Generation & Water
ABB is a leading provider of integrated power and automation solutions with unparalleled experience in partnering with the energy and water industries, bringing them improved operations and sustainable progress. We deliver integrated and secure digital systems, services and solutions to automate and optimize the performance of conventional and renewable power plants and water facilities.

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abb.com/powergeneration
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