

WHITE PAPER

ABB Ability™ Collaborative Operations

A new model for the digital era

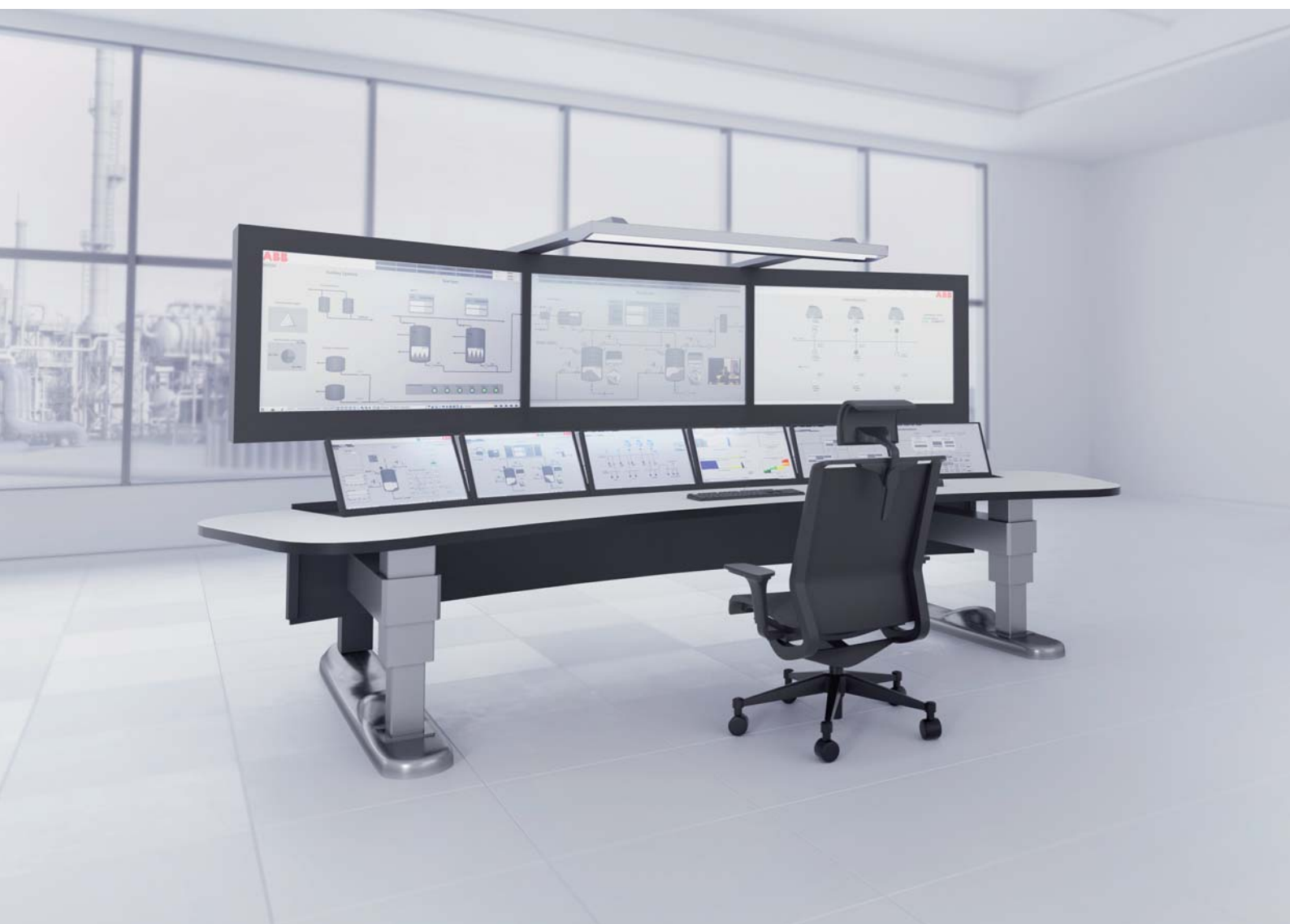




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1. Introducing ABB Ability Collaborative Operations for power generation and water

When utilities automated plants in the 1980s and 1990s, output was raised to new levels. After that, companies invested in enterprise resource planning (ERP) systems, outsourcing non-core tasks and centralized information technology (IT). This allowed them to manage their organizations more efficiently at lower cost. These were capital investments which, when completed, made the companies more efficient. It is widely agreed that to raise productivity and profitability again, as part of the Fourth Industrial Revolution, data utilization will play a key role. However, it is not only more data that is required, rather it is the analysis and expertise needed to drive data-influenced actions that will increase productivity, optimize processes and reduce costs for utilities.

This new way of working requires the close collaboration of experts from across the organization and its service providers. It also requires understanding the context of the operations and then combining that understanding and expertise with the right data to allow plant operators to identify, prioritize and act quickly to mitigate process bottlenecks that impede performance. Most companies lack these insights, so they end up with more data but not the agility they need to improve productivity or profitability.

ABB calls this new way of delivering services to customers **Collaborative Operations** – combining the power of digital solutions with process and technology expertise.

1.1 Collaborative Operations and Collaborative Operations Centers

The four key aspects of Collaborative Operations are:

- 1 People:** Collaborative Operations connects the customer's staff - at the plant, fleet and company headquarters - with ABB technology and process experts, enabling them to work together and improve plant performance.
- 2 Places:** Collaborative Operations connects the customer's sites and infrastructure - plants, units, facilities and head office - with the ABB Collaborative Operations Center.

3 Platform: Collaborative Operations combines ABB Ability and the Microsoft Azure cloud into a powerful technology platform for advanced applications. Through a high-speed, cyber-secure connection, the Collaborative Operations Center monitors a comprehensive range of key performance indicators to ensure that the plant or fleet is operating optimally within regulatory, load and process requirements.

4 Profitability: Collaborative Operations services and advanced applications help customers to optimize operations, increase productivity and reduce costs, releasing more money to the bottom line.

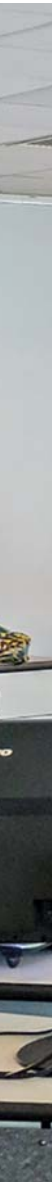
The Collaborative Operations Center is an access-controlled physical location, at which information technology and operations experts work together within one center. The Collaborative Operations Center typically consists of:

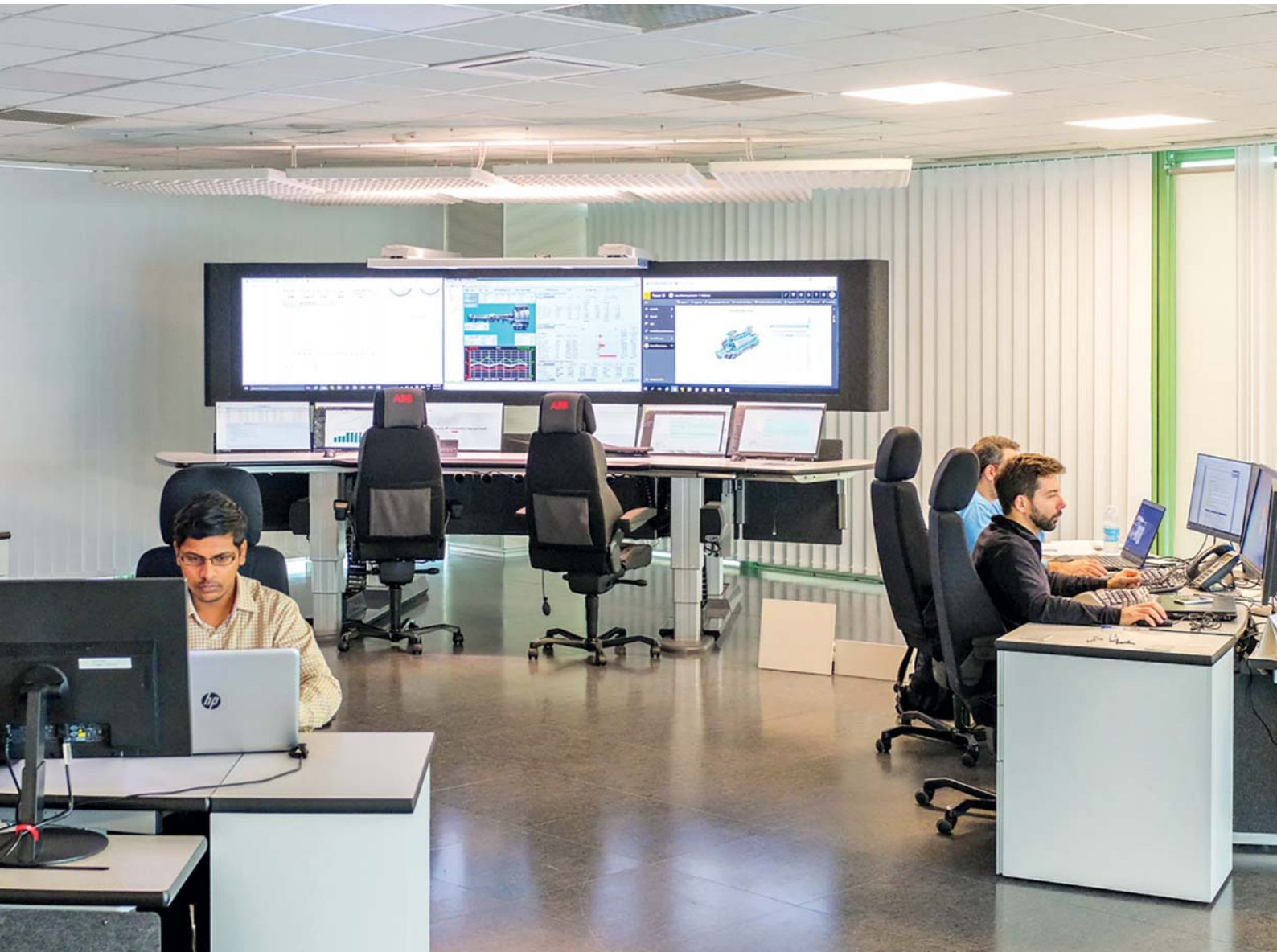
- A control room with four main operator stations designed for at least two operators
- One collaboration room
- One meeting room
- An ABB Remote Monitoring and Operations Room (ARMOR)

The Collaborative Operations team monitors the plants, assesses and analyzes data, and advises customers of the insights provided by the data. ABB believes that locating the experts in a single center enables ABB to most effectively serve its customers.

1.2 How Collaborative Operations is different from remote monitoring and 24/7 care

Remote diagnostics and 24x7 care are services that ABB has provided for more than 15 years. The Collaborative Operations Center is an evolution of these remote monitoring and 24x7 care concepts. It builds on those two fundamental service offerings to support customers from a permanent service center, rather than in an ad-hoc fashion from multiple service centers.





Historically, ABB's remote diagnostics offering supported global remote monitoring, troubleshooting and corrective or scheduled maintenance. Through these services customers had access to ABB remote monitoring technicians who were experts in ABB control system platforms and familiar with commissioning and troubleshooting procedures. These technicians were located locally and available to customers when called upon. In cases where deep domain expertise was needed, the technicians would turn to ABB process and operations experts who were located in various parts of the world and not always 100-percent dedicated to customer support. There was a time lag between the technician connecting with the experts and the experts providing the customer with a solution.

Now, with the Collaborative Operations Center, we have made two important changes:

- 1 The center is staffed with experts who are located at one site and fully dedicated to support ABB customers
- 2 Customers receive immediate support, as the experts are available on-site in the center.

Further, Collaborative Operations requires a different type of expert. In the past, ABB experts focused on developing DCS expertise. Now, while DCS expertise is the foundation, ABB has added experts in the following domains:

- Process and diagnostics
- Remote monitoring
- Electrical automation
- Equipment
- Instrumentation

This allows ABB Collaborative Operations experts to provide data insights to customers at the plant, fleet and enterprise level.

1.3 A global collaboration model

The focus of Collaborative Operations Centers is on the services and offerings they provide, not on their location. A center can easily serve customers all over the world. Centers may have a focus area of expertise (such as ABB Ability™ Symphony® Plus or ABB Ability™ System 800xA) or language capability. Below are the global locations for ABB Collaborative Operations Centers:

Power Generation & Water

- Genoa, Italy
- Mannheim, Germany
- Singapore
- Bangalore, India (to be decided, TBD)
- Americas (TBD)
- China (TBD)

ABB Collaborative Operations Centers for other industries:

- Westerville, Ohio (pulp and paper)
- Helsinki, Finland (pulp and paper, robotics and motion, electrical products)
- Shanghai, China (chemicals, control technologies)
- Oslo, Norway (oil and gas)
- Västerås, Sweden (mining, control technologies, service)
- Houston, Texas (oil and gas, chemicals)
- Bangalore, India (oil and gas, chemicals, mining, metals, pulp and paper, control technologies)

1.4 Using digitalization to achieve real business value

Collaborative Operations provides the following benefits for customers in the power generation and water industries:

- Up to 20% extension of machine life by using immediate and trend data insights to better manage equipment and asset utilization
- Up to 50% reduction in maintenance costs by using smart predictive methodologies, rather than reactive/routine maintenance scheduling
- Customers have deeper visibility into equipment, plant or fleet performance, which enables them to understand actual performance capability and operating limits.



2. How the Collaborative Operations Center works

Customers have direct access to the Collaborative Operations Center. They can connect with the ABB experts at the center in the following ways:

- Log a case: customers can log and monitor a case directly via the case management tool
- Direct phone line: Collaborative Operations experts are available from at least 8:00 – 18:00. An expert will respond to customers within 15 minutes 24/7 during non-office hours
- A dedicated email address
- Desktop sharing and a secure PC-to-PC remote connection to facilitate collaboration on troubleshooting by ABB and the customer

Collaborative Operations experts proactively monitor customer needs and provide recommendations for process improvements. The experts have deep knowledge of ABB DCS technologies and use advanced tools to support troubleshooting and provide fast solutions to ensure DCS availability. They engage other expertise within ABB to assist with troubleshooting, as required.

Typical Collaborative Operations deliverables are:

- Monitor customer dashboards and alert the customer of abnormal situations. The depth of monitoring is determined by the customer
- Prepare monthly (high level) and bi-annual reports (deep dive), which include recommendations for the customer
- Host periodic conference calls with the customer to review the results and recommendations resulting from data insights. The frequency of the calls is determined by the customer

2.1 Global offerings provided by the Collaborative Operations Center for power generation and water

The main solutions delivered via Collaborative Operations for power generation and water include (but are not limited to):

- Vibration monitoring: The vibration monitoring solution empowers operators to proactively protect their rotating assets to keep employees

safe, enhance the performance of capital equipment and optimize operational efficiencies. The solution provides early visibility into potential causes of failure, real-time vibration thresholds and trend analysis, tailored for the plant by Collaborative Operation experts, to help customers save time, resources and maintenance costs. The vibration monitoring solution is available for all rotating machinery such as turbines, generators, motors, fans, pumps, etc.

- Performance monitoring: The performance monitoring solution provides customer personnel with visibility into real-time plant performance measured against key performance indicators (KPIs) such as heat rate and efficiency, insights into the cause of any deviation, and actionable recommendations to improve the necessary KPIs to operate at optimal efficiency. When performance monitoring is extended across a fleet of assets it provides visibility into fleet performance and allows power generation companies to benchmark their sites and apply lessons learned from individual classes of equipment or plants to an entire operation.
- Loop tuning: The loop tuning solution increases visibility into control system performance by quickly diagnosing disruptive loop tuning issues and predicting potential process disruption. The solution combines domain expertise and advanced algorithms to report customer-specific KPIs that improve control system maintenance planning.
- Additionally, Collaborative Operations provides solutions that address cyber security and region-specific requirements in areas like emissions monitoring and energy management.

3. Strategic partnerships

The ABB Ability platform is a set of enabling technologies that allows ABB to build solutions quickly and efficiently. We are building the platform from best-in-class industry technologies, such as Microsoft's Azure cloud services, IBM Watson's machine learning and artificial intelligence, and SAP HANA's big-data query tools.

3.1 The partnership with Microsoft Azure

The Collaborative Operations Center utilizes advances in data usage and analytics through a new technology platform, which is a combination of ABB Ability and Microsoft Azure. This enables ABB to connect directly to customer sites or do bulk uploads of data, then use that data to apply logic, perform analytics, create dashboards and provide customers with actionable insights. This optimizes analytics and continuous support for the daily operation and maintenance activities of the customer's assets.

Microsoft Azure is the platform for ABB Ability applications. ABB's Chief digital officer, Guido Jouré, explained that the choice of Microsoft combines that company's cloud reach with ABB's domain-specific software products. He emphasized ABB's viewpoint that there will be no "binary outcomes" in the Industrial Internet of Things (IIoT) cloud platform market. Rather, multiple cloud service platforms serving the IIoT will persist and one of the major differentiators for these platforms will be their ease of integration. Envisioning a future of "intercloud" integrations, ABB believes, lends extra weight to its choice of Microsoft as the primary platform, given its massive developer base.



4. Remote connectivity

4.1 The key components

The Collaborative Operations Center uses Gateway, Connector and IoT cloud infrastructure to establish remote connections. Figure 1 on page 10 shows the Collaborative Operations data flow process – how data is collected, filtered and transferred into the cloud, and Figure 2 (p. 10) the components that facilitate the data flow process from the plant to the Collaborative Operations Center.

The four key hardware and software components that transport data from the plant to the center are:

- 1 Advanced application software** – filters and analyzes raw plant data, which is typically operating data used to understand the performance or condition of equipment. The output of this software is the performance monitoring KPIs.
- 2 Connector** - collects KPI data from the automation systems and advanced applications and stores them in an on-premise database.
- 3 On-premise database** - contains an application or device data information model and the raw data retrieved from the vibration monitoring system.
- 4 Gateway** – transfers the data to the ABB Ability cloud through an edge-to-platform connectivity module

The data transformation process described above allows experts to view operating information via a dedicated web portal. The information that is visualized includes:

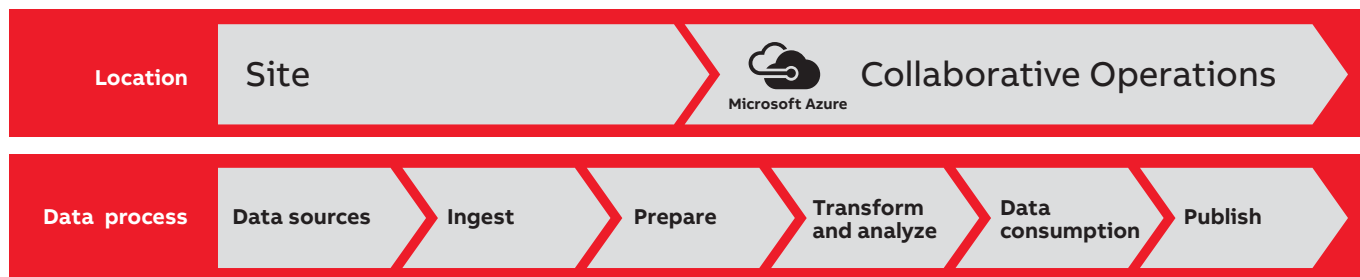
- Historical operational dashboards for cross-fleet analysis
- Algorithms for predictive analytics
- Online operational dashboards

One of the key outputs of Collaborative Operations solutions is the visualization of data. Most frequently, ABB uses the Microsoft Power BI tool for its online dashboards. The dashboards are viewable by Collaborative Operations experts and customers. The two types of dashboards are real-time performance and historical trends (Figures 3 and 4 on page 10).

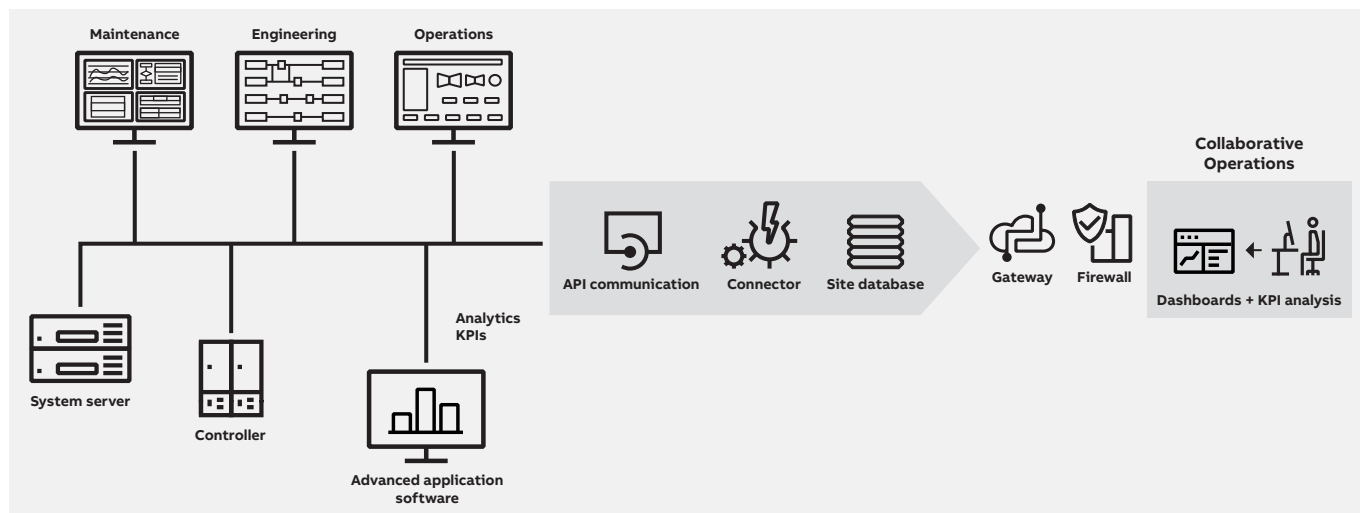
4.2 Collaborative Operations – implementation options

There are two ways to implement Collaborative Operations solutions.

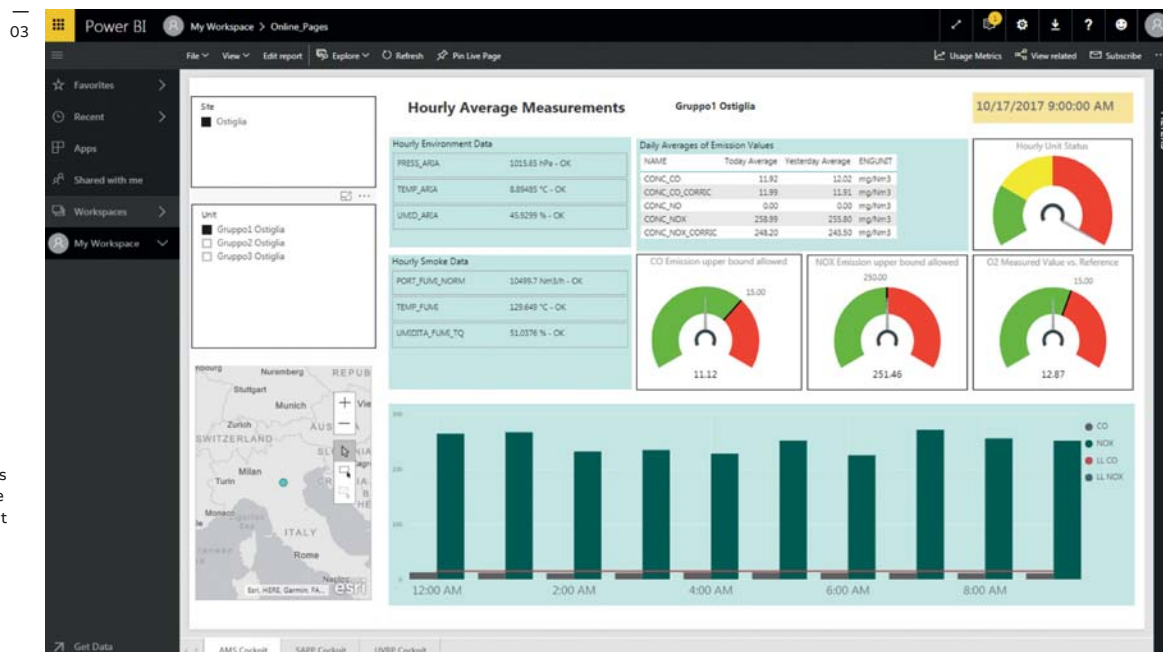
The solutions are installed at the plant and the data is transferred either to the Collaborative Operations cloud (on-premise) or on a cloud as a service basis. Currently, the most popular method is on-premise. This uses edge computing to optimize cloud computing systems by performing data processing locally near the source of the data (at the customer site), rather than transferring the data to a centralized cloud. Data is processed at the edge, after which some or all of the data is sent to the Collaborative Operations Center. This is made possible by the fog network, which is the connection between edge devices and the cloud.



01



02



01 Collaborative Operations data flow process

02 The components in the data flow process

03 Real-time performance dashboard shows equipment performance at any given time against predetermined KPIs

5. ABB's Data Manifesto

5.1 Ensuring data protection, privacy and protecting the customer's IP

ABB understands that data ownership is a concern of many customers. So, we created a data manifesto to inform customers about ABB data/ intellectual property (IP) management procedures. Our use of the customer's data is based on the following three core principles, as defined in ABB's Data Manifesto:

Your data remains yours

"Your data" is all the data you provide to us and all the data we collect from you that you generate when using our services and products and that are measured by or through our devices. To the extent such data can be attributed to you and is specific to your environment, we agree that your data remains yours.

You know what we do with your data

It is of utmost importance to us that you know how we use and store your data and to what extent you can retrieve your data from us. We are transparent with you about the data we measure and collect. We only use that data with your consent to provide services and products to you, to improve those products and services, and to develop and provide new and better products and services in the future.

We will not disclose your data without your consent

We will not disclose your data without your consent or without having compelling reasons to do so, such as if we are legally obligated to do so or to fulfill our contract with you. We take strong

measures to protect the security and privacy of your data. We allow only our own personnel and those of our subcontractors such access to your data as is necessary for them to perform the tasks assigned to them, and we will not allow them to use your data for any other purpose.

5.2 Ensuring data/IP is not shared with or used for the benefit of competitors

We use the multi-instance approach, which is not based on large central database software and infrastructure. Rather, instances are deployed on a per-user basis, allowing the multi-instance cloud to scale horizontally and infinitely. Separate application logic and database processes are assigned to each customer, giving them a unique set of instances that are dedicated to their organization and needs.

This means that customer A's data will be hosted in an isolated and protected area of Azure's environment separate from Customer B's. But this is not enough. ABB sets up group policies and credentials in an Azure active directory (AD) for ABB employees, allowing them access only to the database that is aligned with the customer they are collaborating with.

There is always at least one administrator who has access to all customer information. The administrator must comply with the ABB Integrity Standards and Data Manifesto.

6. Cyber security

6.1 Cyber security overview

Security is handled in two different ways - within ABB and in the cloud. The ABB IT security team has dedicated experts who manage the security of the ABB global IT network and the Collaborative Operations Center. Microsoft is responsible for the cyber security of the cloud (Azure).

The Collaborative Operations Center ensures robust cyber security in the following ways:

- Uses the ABB global IT network, which allows the ABB cyber team to monitor, respond to and resolve any security-related concerns. This includes routine actions like applying the required security updates to address cyber vulnerabilities proactively according to the defined ABB policies
- Maintains strong, high-performance security foundations to protect ABB information system infrastructure and applications (in-house or cloud-based)
- Embeds appropriate information security behavior in ABB's employee culture
- Applies standard, continuous measurement of security control quality and risk levels to dynamically address new threats
- Increases ABB resilience to security attacks with 24x7 advanced threat detection and monitoring and adaptive incident response
- Secures remote connections using the latest security technologies and strategies
- Encrypts all data within the center, both in transmission (transferring on-site to the cloud) and at rest to reduce the impact of any security breach.

If a security incident were to occur, ABB would follow its cyber security incident response process.

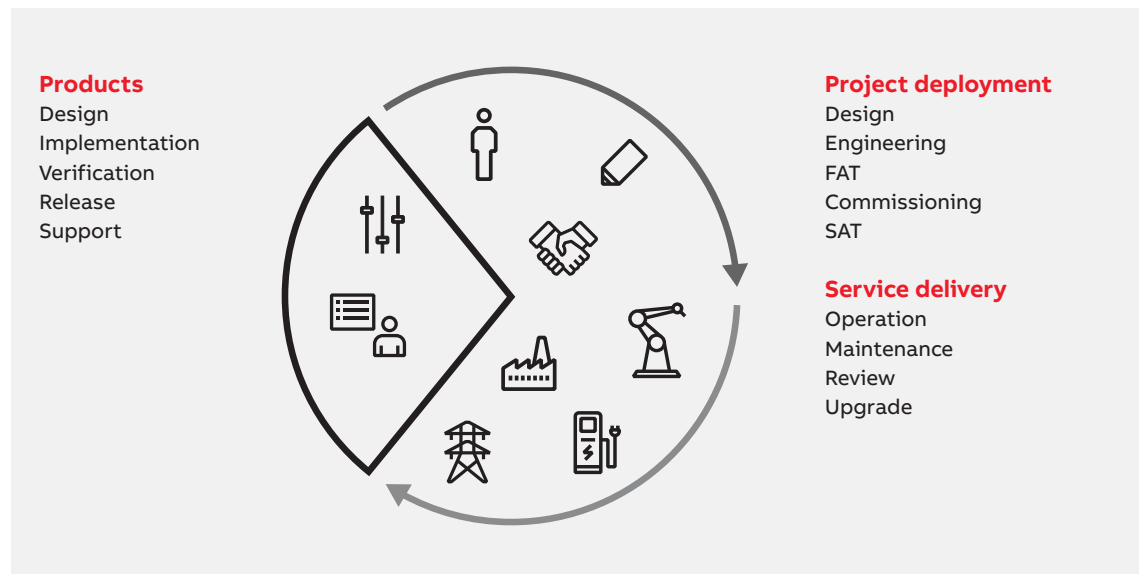
Microsoft is responsible for the cyber security of the Collaborative Operations Center cloud (Azure): "Microsoft has decades-long experience building enterprise software and running some of the largest online services in the world. We use this experience to implement and continuously improve security-aware software development, operational management, and threat-mitigation practices that are essential to the strong protection of services and data."

"The guiding principle of Microsoft's security strategy is to 'assume breach.' The Microsoft global incident response team works around the clock to mitigate the effects of any attack against their cloud services. And security is built into Microsoft business products and cloud services from the ground up, starting with the **Security Development Lifecycle**, a mandatory development process that embeds security requirements into every phase of the development process." (<https://www.microsoft.com/en-us/trustcenter/security>)

6.2 ABB Secure Development Lifecycle (SDL):

Security at ABB is implemented throughout the development life cycle of our product lines. ABB believes that security practices should be built in at the people, process and technology levels, not just added at the end.

—
Secure design throughout the life cycle



SDL - People

ABB screens its employees to ensure that they are not a risk to ABB or ABB's customers. We use open source searches, criminal background checks and check references prior to offering employment. In addition, when an employee is hired, they must agree to the ABB Code of Conduct. ABB expects every employee and stakeholder to behave with responsibility, respect and determination. For product and software developers, ABB provides anyone who can influence application security – such as project managers, development managers and application developers - with the training, awareness and resources they need to be secure and successful.

SDL - Process

Software Development Improvement Program (SDIP) was launched in 2008 as an ABB Group initiative and chartered to transform the way ABB develops software. SDIP brings ABB's software R&D above and beyond the industry average to achieve speed, quality and predictability in ABB's software product development. ABB follows not only best practices such as malware protection, extensive testing and patch management in its development processes, but also advanced practices like code signing, design guidelines and patterns for security, security assessments and threat modeling.

SDL – Technology

The ABB IT security team has dedicated experts who manage the security and design of the ABB global IT network and the Collaborative Operations Center. Microsoft is responsible for the cyber security of the cloud (Azure).

ABB realizes that cyber security is a journey and therefore provides expert advice to address specific technical or country regulatory requirements.

Conclusion

ABB Ability Collaborative Operations is a new operating model that combines digital solutions and objective data insights from Collaborative Operations experts. The goal is to provide ABB customers with the right data insights, at the right time, to drive the right action. ABB is looking forward to partnering with our customers to harness the full potential of their data and increase their profitability.

The ABB Ability platform is a set of enabling technologies that allows ABB to build solutions quickly and efficiently. We are building the platform from best-in-class industry technologies, such as Microsoft's Azure cloud services, IBM Watson's machine learning and artificial intelligence, and SAP HANA's big-data query tools.

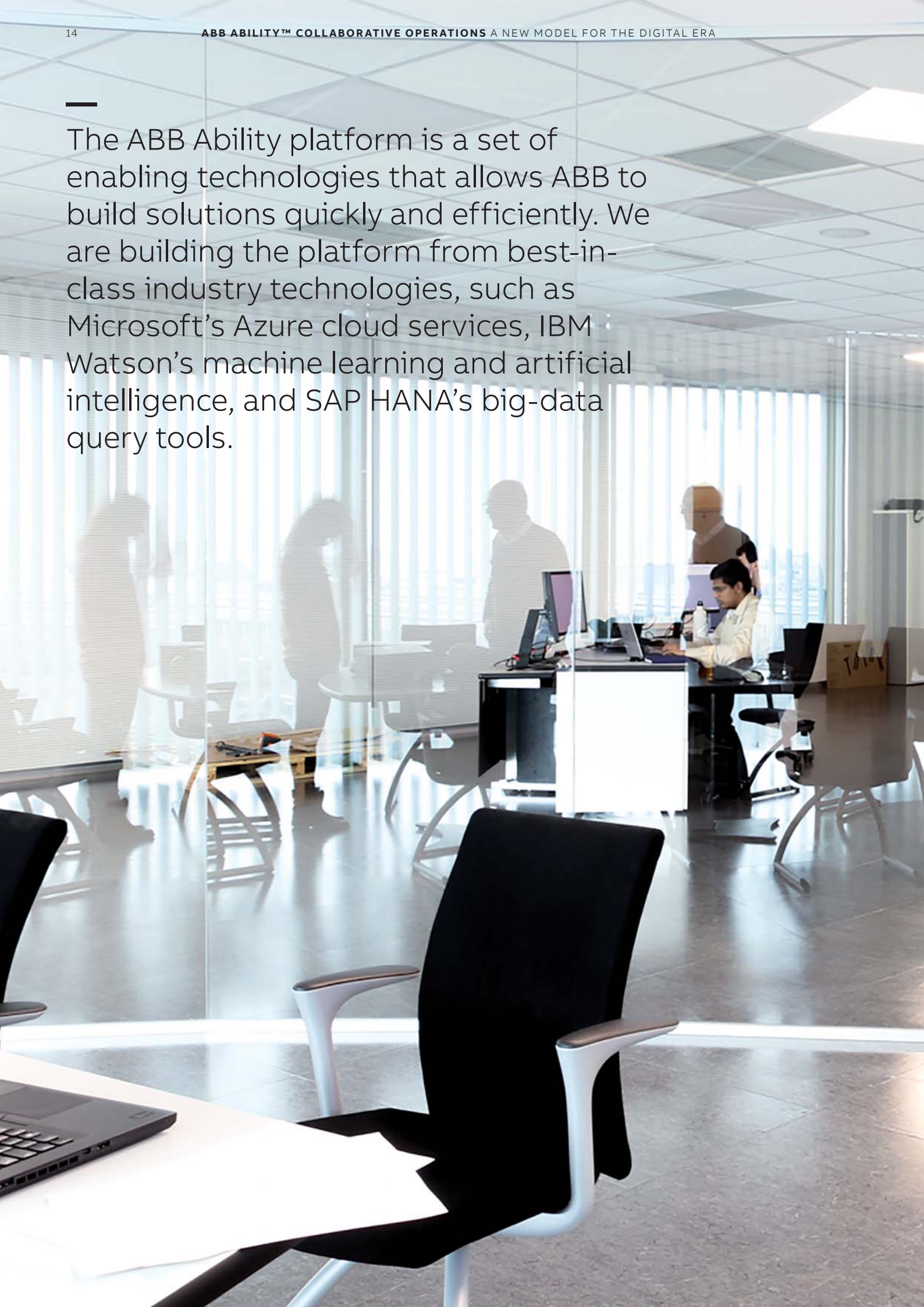




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