



ABB-MICROSOFT JOINT GUIDE

Getting started with industrial digital transformation

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Introduction



In today's complex, hyper-connected, increasingly globalized world, successful business leaders need accurate, real-time access to operational data to support better business decision making. Digitalization – enabling optimization, streamlining, and automation is becoming increasingly important in innovating data-driven solutions and improving business results. While access to data has always been important, the scale and magnitude have exponentially increased, now including physical assets, factories, plants spread across multiple geographies, industry domains, and regulatory frameworks.

In the past, the management of industrial technology in manufacturing has been divided between information technology (IT) and operational technology (OT). Traditionally, IT provided top-down technology support for management and administration, while OT was built from the ground up to monitor and control equipment, systems, and processes. In these legacy roles, IT and OT have lived apart, with limited ability to connect OT data to IT systems.

In recent years, advances in connectivity, big data, and the expansion of the Internet of Things (IoT) have led to a new breed of intelligent manufacturing technology that is impacting both IT and OT. For the modern manufacturer, data has become unified and ubiquitous across the organization, from supply chain management to the manufacturing operations, and is one of the most valuable assets in every industrial operation.

As a result, IT and OT can no longer operate independently and have started to converge, opening the door to previously unseen opportunities. The focus is shifting from administrative systems to a core business imperative to integrate data at all levels for bottom-line and top-line growth.

Today, data-optimized smart machines can receive input from a wide range of sources – from customer order data to production data – to enable more agile manufacturing, improve production safety and efficiency, enable remote and mobile operations and provide greater insight into operational performance. Integrating data from equipment, processes, plants and business systems gives business leaders organization-wide visibility and control. Connected systems can communicate to detect unbalanced load flows and automatically make corrections to prevent outages. Digital transformation in collaboration with partners enables enterprises to set new global manufacturing standards and create world class value to end customers in a sustainable, durable and profitable way.

This paper provides decision makers with insights into starting digital transformation as well as best practices for real-world industrial implementations. You will also learn how ABB and Microsoft have transformed our own businesses and combined our collective knowledge and capabilities to support you in defining and executing your enterprise digital transformation.

Business value from digital transformation

Businesses today face both internal and external challenges driven by key industry trends and imperatives (see Figure 1). ABB and Microsoft have formed a strategic partnership to help customers connect their systems and data to facilitate their transformation into a digital enterprise.

Why become a digital enterprise?

Today, digital transformation is not optional – it's a must. For the first time, technology has outpaced business processes, putting pressure on companies to constantly improve their day-to-day performance. With IoT, they are creating new digital feedback loops that connect customers,

operations, employees and products. Many are gaining a competitive advantage – and creating higher value for their stakeholders – by leveraging digital technologies to create differentiated business models and bring excellence to everything they do.

Companies are reinventing themselves through digital technologies that enable seamless deployment of continuous, reliable, and scalable processes at an optimized cost. Aligning people, process, data and tools is allowing businesses to achieve excellence and deliver safe, dependable, and profitable production.

Figure 1. Drivers affecting change



Industry Trends

- 20% productivity gain from smart factories¹
- 75% of chemical companies will double digitalization efforts by 2020²
- #1 use case for manufacturing is predictive analytics³
- 70% of companies expect increased demand for AI-enabled products and services³



Imperatives

- Seize Industry 4.0 opportunities by leveraging digital capabilities
- Implement smart factories to gain competitive edge
- Increase revenue while improving productivity



Challenges

- Mitigate threats with comprehensive cybersecurity measures
- Manage workforce evolution as aging employees are replaced by automation
- Manage digitalization-driven culture change
- Demonstrate ROI on digital investments
- Bridge skills gap

1. IDC FutureScape: Worldwide Operations Technology 2017 Predictions Jan 2017 Doc# US42261017 Web Conference By: Lorenzo Veronesi, Marc Van Herreweghe.

2. 2016 Global Industry 4.0 Survey – Industry key findings; PricewaterhouseCoopers LLP.

3. The Economist Intelligence Unit, Intelligent Economies: AI's transformation of industries and society, (July 2018).

Equally important to establishing a data estate is defining an in-depth cybersecurity strategy. Data privacy, trust and compliance are core to any transformation strategy.

There are many ways to achieve impact at scale – either through vertical or horizontal integration – that are not mutually exclusive but rather complement each other. They include:

- Innovation of the production system: Expanding competitive advantage through operational excellence.
- Innovation of the end-to-end value chain: Creating new businesses by changing the economics of operations.

Key value drivers for transformation include advanced analytics supported by big-data decision making, democratizing technology on the shop floor, agile working models, low incremental cost to add use cases and new business models. Industry strategy, built-for-scale IoT

architectures, new skills that help build capacity, and workplace engagement are all key to scaling these engagements.

Digital transformation requires an agile mindset to power innovation that creates a competitive edge for companies. Data has become the new currency for decision makers, providing a more reliable way to drive optimization and move quickly and confidently in business operations. The speed of integration is a major factor for success.

Integrating IT and OT is the starting point for the digital enterprise

In the digital enterprise, everything is connected. Data flows seamlessly between operational systems and business systems, enabling new capabilities such as process optimization, predictive maintenance, asset management and data-driven decision making. However, in most companies IT and OT have lived for decades in separate worlds. The first prerequisite for digital transformation is to bring these two worlds together.



In an industrial environment, data flows continually, both horizontally (machine to machine) and vertically (devices/machines to systems). Horizontal integration within the information ecosystem empowers every role in the organization to achieve individual and collective objectives. Vertical integration across siloed business systems brings never-before-seen insights. A system of records that effectively leverages data regardless of its source is a key differentiator for organizations in a global economy, improving operations and optimizing costs, quality and productivity.

Yet an IDC report revealed that more than 60% of operational excellence programs don't achieve the desired results because they lack a well-defined transformation plan.⁵ The partnership of ABB and Microsoft brings together complementary capabilities to help customers bring both sides of the business together to achieve the transformation they need. Our ready-to-deploy, highly flexible production solutions built on proven cloud technologies facilitate higher return on investment and lower total cost of ownership.

Additionally, many companies lack a comprehensive approach to cybersecurity, leaving their most valuable assets vulnerable to attack. Compounding the problem is lack of clarity between IT and OT leaders about who is responsible for cybersecurity. While there are significant differences between business and operational systems, smart operations leaders can apply many IT lessons-learned to their OT systems. The key to swift, effective action is a holistic approach that harmonizes the talent, commitment, knowledge, and capabilities of both IT and OT professionals.

Our approach is to help industrial companies use the hard-won, long-fought lessons of IT to leapfrog to an advanced state of IIoT security – expertly architected and deployed to meet OT's differentiated requirements.

Satish Gannu,
Chief Security Officer, ABB

In beginning a digital journey, it is important to focus on business value as opposed to merely deploying the latest technology. A recent study by the World Economic Forum⁶ compared the value created by a variety of use cases, such as digitizing the customer experience and operations, improving quality and productivity, and using agile methodologies in data-driven proofs of concept, among others. Some of the scenarios that showed high business value included a digital performance use case that improved overall equipment effectiveness (OEE) by 35 percent, and a predictive maintenance use case that reduced downtime by 25 percent.

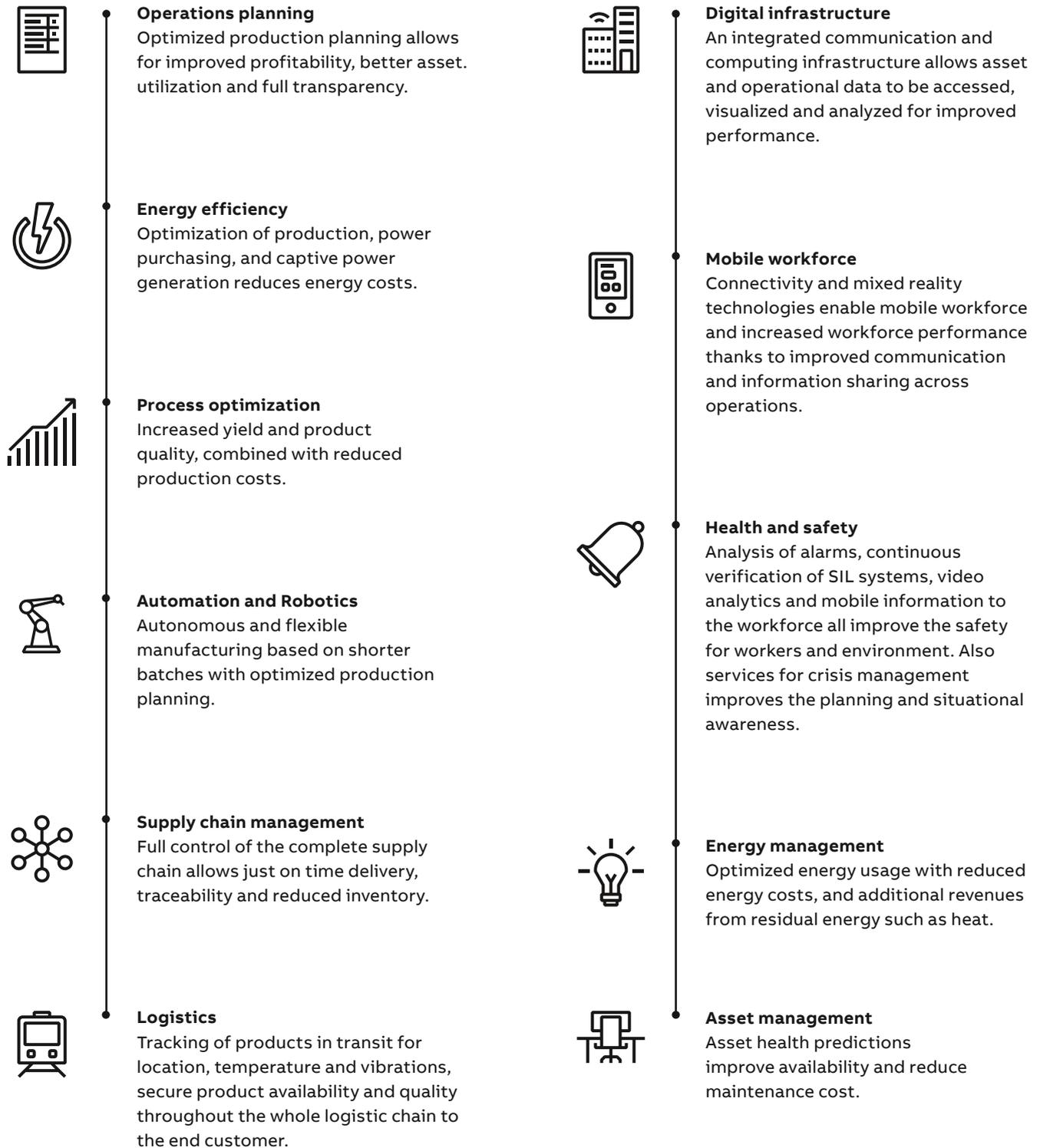
This is where ABB and Microsoft's domain knowledge becomes so crucial in designing a transformation journey. Microsoft's own transformation in their supply chain organization achieved massive gains in a variety of areas. These included year-over-year savings of \$50 million from reduced errors and omissions, and \$10 million from yield improvements and reduced scrap. Similarly, ABB's investments in digital transformation have increased productivity in customers' plants and in more than 60 ABB manufacturing facilities globally. ABB semiconductor production in Switzerland won the A.T. Kearney "Factory of the Year 2018" prize in the category "Excellent Location Safeguarding by Digitalization" for increasing competitiveness through digitally connected production. We draw on this combined track record to help customers uncover the value hidden within their digital initiatives.

Digital transformation reaches across an entire organization and impacts all aspects of business. It requires cultural change management from beginning to end, and runs from collaborative design and operations centers to management of industrial assets across the globe. This requires a holistic view of the business landscape covering process optimization, utility, energy, supply chain and logistics, a mobile workforce, and health and safety (see Figure 2). The principal drivers of operational transformation are connectivity, intelligence and flexible automation. Embracing these trends will create a step change in performance.

5. IDC FutureScape: Worldwide Operations Technology 2017.

6. World Economic Forum, Fourth Industrial Revolution Becons of Technology and Innovation in Manufacturing, 2019.

Figure 2. Selected use cases for digital transformation across industrial value chain



How to get started in digital transformation

When embarking on a digital transformation journey, it is important to put in place the foundational elements for success. This involves balancing both short- and long-term targets, driving rapid change while keeping sight of the larger vision.

To support this process, ABB and Microsoft have built a framework to drive and manage the transition as smoothly and efficiently as possible (see Figure 3). There are three focus areas within this framework: building a foundation for success by understanding the starting point and forming internal and external partnerships; creating the vision, including targets and roadmaps; and driving the change to tangible business results.

Building the foundation

Setting a solid base will help determine the success of your overall transformation initiative. Begin with these critical activities:

- Identify critical pain points and define clear objectives
- Assess data architectures, IT systems, and communications networks
- Adopt an agile and collaborative way of working with quick-win proofs of concept that demonstrate value
- Establish and empower a cross-functional innovation team with a clear strategic mandate
- Build multi-stakeholder forums to initiate planning and prioritization
- Establish foundational partnerships with experience at local and global levels

Figure 3. Framework for digital transformation

Building the foundation



Customer Value Workshop

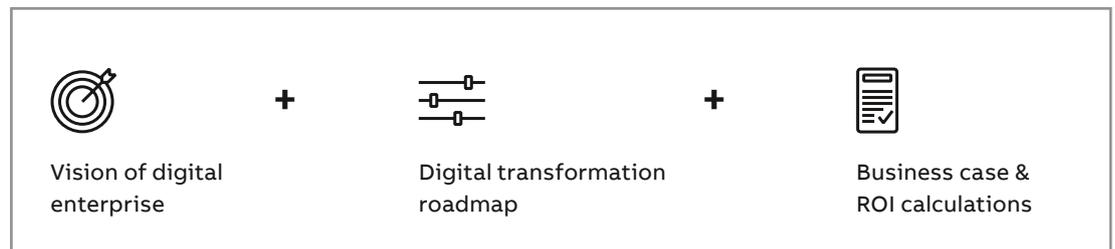


Digital maturity assessment

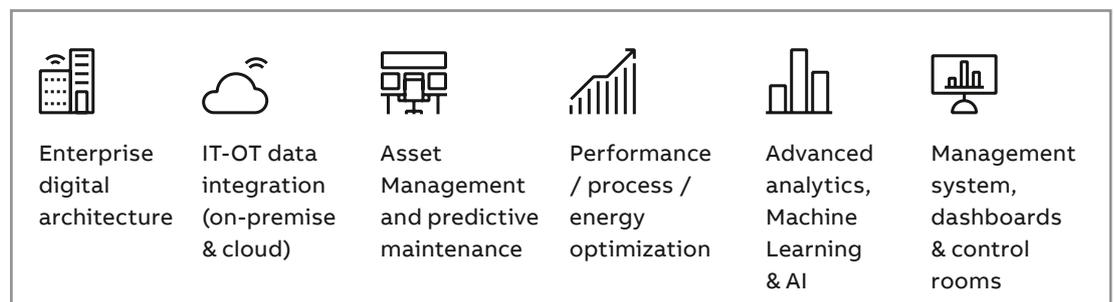


Agile & collaborative approach: Digital POCs

Creating the vision



Driving the change



Establish an agile and collaborative approach

The cultural and change-management aspects are the greatest challenges in digital transformation. Large-scale transformation requires a truly collaborative approach, so begin by creating alignment and introducing a scalable way of working. Orchestrate collaboration not only between the different parts of the enterprise, but also between the enterprise and ecosystem partners. Look for partners who have a strong understanding of the business coupled with a deep understanding of the domain to unlock value for the enterprise. The ecosystem may include partners that compete in some areas while cooperating in others. This dynamic collaboration is how transformation happens – bringing together complementary strengths for the good of the customer.

Co-creation starts with identifying the main value drivers, pain points and objectives. The power of the co-creation model lies in its ability to rapidly move through project phases while adhering to the agreed-upon project parameters, from planning and evaluation to implementation and solution delivery. As Figure 4 illustrates, the combination of business and solution expertise is key to success in this collaborative model.

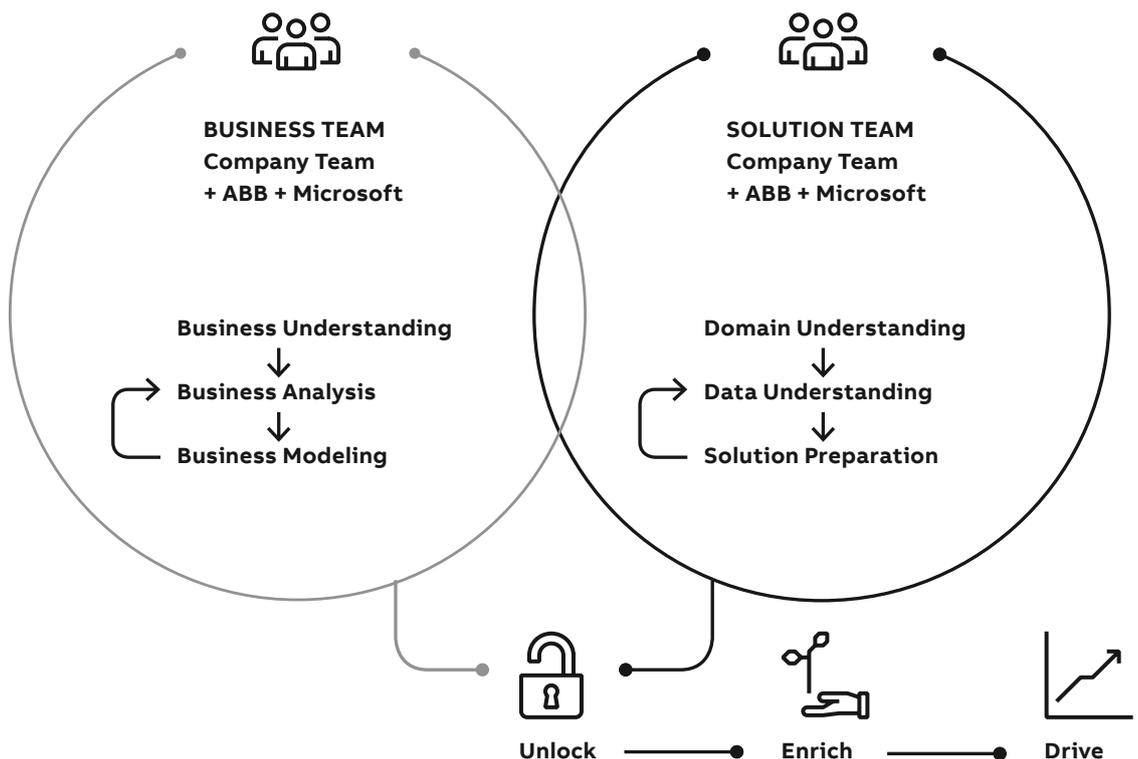
Cross-discipline teams address problems from every perspective, ensuring the best operational technology, industrial knowledge, and domain

expertise is blended with data and technology expertise to benefit all stakeholders. This agile approach is a clear departure from traditional waterfall project management techniques, which put all immediate and future outputs in a linear sequence of discrete phases or projects. It ensures transparency and flexibility while taking into account the changing economic, regulatory and technology landscape.

In this context, we cannot over emphasize the importance of cross-functional innovation teams at the heart of the transformation. The model is well-suited to prioritizing fast and tangible solutions that build broad support for the overall strategy.

Building the journey requires a targeted approach. From value workshop to continuous collaboration, Figure 5 illustrates best practices in delivering an agile program. Initial benefits should come fast and produce increased efficiency and productivity. Identifying quick wins is a demonstration of value creation that can motivate further investment in the later stages of the digital journey. Results from initial projects can be evaluated, calibrated and fine-tuned for larger scale transformation projects within the enterprise. This ongoing collaboration will help build the full potential of transformation in a shared-risk environment.

Figure 4. Co-creation model for tangible business results



Understand the current state through a digital maturity assessment

A vital part of building the foundation is a digital assessment evaluating existing IT and OT capabilities. Thus, it's crucial to get an understanding of the current state in order to plan the necessary steps forward. It is best performed by a cross-functional team with expertise in your domain, IT, OT, process automation, business processes, cybersecurity, and regulatory and statutory requirements.

This assessment report gives a true picture of the IT/OT integration landscape and a guide to the scope of work and resources needed. Based on your priority, the areas for integration can be earmarked and pilot projects can begin. The results of the pilot integration projects will drive the decisions on how to approach the large-scale integration.

A typical assessment report should list the evaluated zones of the plant, provide information on the data sources (machines or systems), the data transfer protocols, and the expected throughput. Depending on the business requirements, the data can be handled at the edge or in the cloud, using standard industrial fieldbus protocols.

Creating the vision

Having established an agile approach, created an initial view of the possibilities and formed teams and partnerships, the next steps are to create and launch the larger vision and roadmap for the new digital enterprise:

- Create a digital vision from outside in to transform your value creation
- Define a step-by-step roadmap, digital program and metrics together with partners
- Start projects to collect, aggregate and analyze data for critical pain points and use cases
- Turn digital projects into ongoing collaboration to create long-term results
- Launch and maintain the vision, roadmap and communication to all stakeholders

Building the foundation for the digital journey should include creating an attractive and understandable outside-in digital vision that is aligned to the overall company vision. The main questions are how to provide new value in existing customer relationships, how to create new business opportunities outside traditional ones and how to show digital leadership in the industry. Digitalization brings customers, suppliers, partners and disruptors together to formulate the new vision. The company can use key partners to better understand latest trends in digital technologies in, for example, industrial processes, cloud technologies, artificial intelligence (AI) and mixed reality.

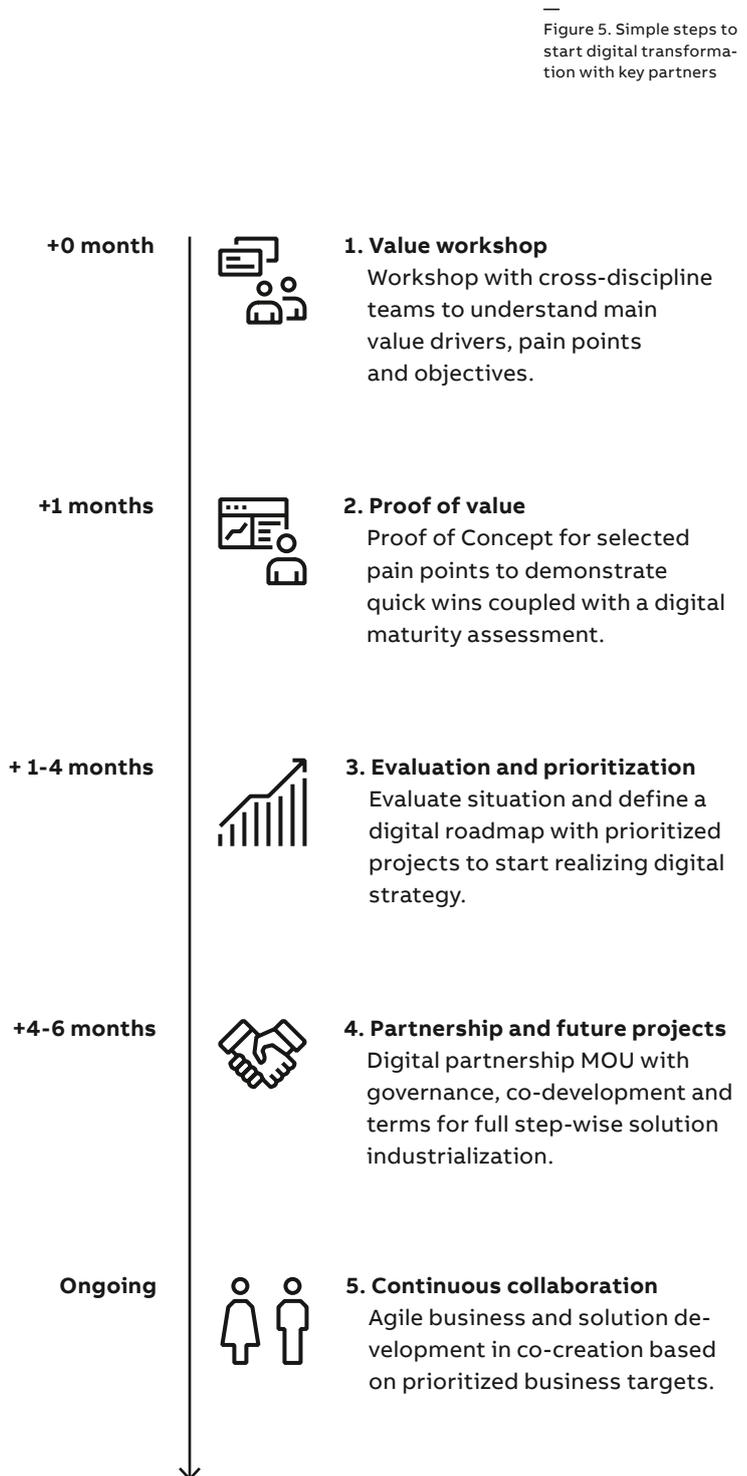


Figure 5. Simple steps to start digital transformation with key partners

When creating a roadmap to achieve the formulated vision, we recommend a phased implementation so that each step builds further capabilities and moves toward more advanced solutions. Start by getting access to the data, then gradually expand toward more advanced functions. (See Figure 6.)

Initially, the emphasis is to get access to disparate data sources, including manufacturing, control and business systems. This provides a 360-degree view of current operations and serves as a baseline for transformation and prioritization. You can then gain added insights by modeling and analyzing operational data. Analytics help redefine benchmarks for business and set the path for long-range transformation goals. In this step, optimization solutions are also deployed for prioritized use cases such as asset condition monitoring, performance management and energy optimization. Finally, more advanced real-time analytics, artificial intelligence and prescriptive models are deployed to achieve continuous learning, further optimization and more autonomous operations.

Also consider how the company can better use internal and partner expertise. For example, collaborative operations with centralized connected expertise enables process, equipment

and technology experts to remotely troubleshoot reactive issues and make proactive optimization recommendations based on data analytics and insights. Additionally, look for ways to improve internal efficiency by including managed services as part of the corporate IT landscape in the form of software-as-a-service (SaaS) and data-as-a-service (DaaS) solutions.

Driving the change

The true value of digitalization comes from a determined and long-term change process, where continuous improvements and co-creation generate growing profitability and value. To maximize likelihood of success,

- Collaborate with implementation partners on detailed planning and phasing of projects
- Ensure access to critical data with IT/OT integration and plan an infrastructure that will allow sufficient scalability
- Consider key infrastructures, architectures and their critical dependencies
- Start from quick-win projects that introduce operational savings by analyzing and visualizing critical data
- Make key stakeholders levers of change and scaling by communicating early results and success stories

Figure 6. Building the digital roadmap to realize the vision



Getting access to important data

Typically, the data coming from machines and from business systems have not been integrated across the enterprise. However, a need for quicker business response times, condition-based maintenance of equipment and improved connectivity have highlighted the need to integrate data from both IT and OT systems. Increasingly, companies see the business advantage of transparent, real-time access to all available information. Such ubiquitous access depends on integrating data from equipment and machines with IT systems across plants, sites, and the enterprise.

This broad IT/OT integration requires a wide range of expertise – all the way from the low-level interfaces in the Industrial layer to the business-level specifics in the IT layer. The depth and scale of complexity is often increased by a wide variety of legacy equipment, such as various distributed control systems (DCS), supervisory control and data acquisition systems (SCADA) or manufacturing execution systems (MES) that do not have the ready capabilities to make necessary data available to higher layers.

Another challenge is that the OT systems may lack necessary information due to low sensor coverage or legacy instrumentation. These might require additional sensors to capture increased resolution data from smart subsystems and to allow real-time analytics, optimization, and control of the process.

Depending on the company's needs, integrated data can be made available through an on-premises, cloud-based, or hybrid solution. In some industries, hybrid solutions are very common due to data confidentiality, regulations, and business sensitivity.

A best practices blueprint for core infrastructure and architecture

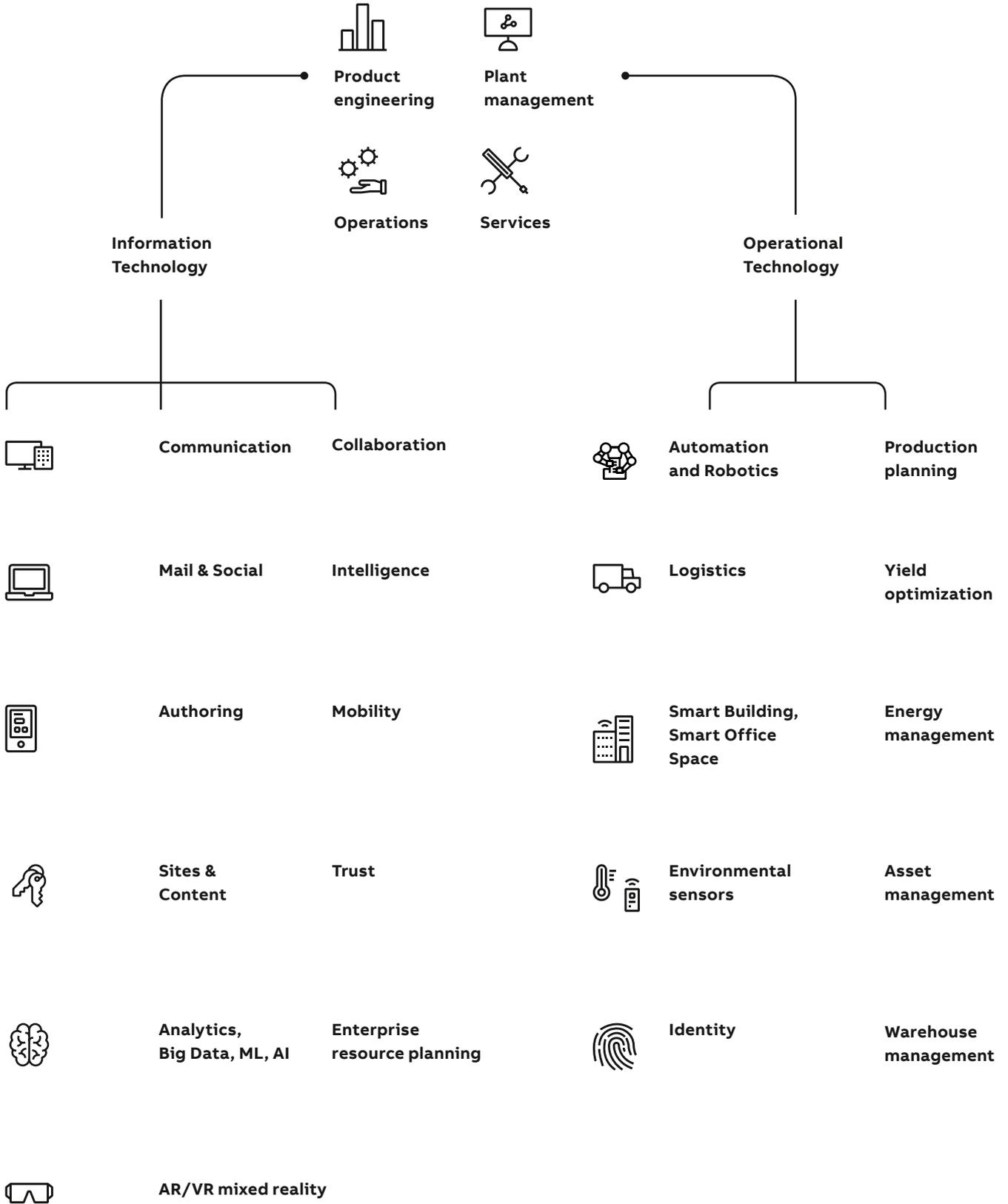
In real-world scenarios, IT/OT integration can be challenging. We see many OT systems producing an abundance of semi-transactional data. This is a big challenge when the enterprise information infrastructure includes heterogeneous information systems, such as enterprise resource planning systems (ERP), manufacturing execution systems (MES), or manufacturing information systems (MIS).

Most industries also live with a long legacy of OT systems from different manufacturers and of various types and age. These incompatible systems can become a massive hurdle for IT/OT integration. Such an integration process typically requires expertise on both the domain and system level and specific connectivity solutions. ABB's proven expertise in sensors, control systems, robotics, energy management, e-mobility and a deep understanding of industries and utilities, along with the experience gained in digitalizing its own factories enable a pragmatic and efficient approach to connectivity and integration.



Figure 7 (below) illustrates the converging roles of IT and OT, and Figure 8 shows an integrated IT/OT architecture for digital transformation.

Figure 7. Convergence of IT and OT



The blueprint solution leverages Microsoft's Azure platform services for an efficient industrial implementation based on the Lambda architecture, where data is normalized to a standardized format with all basic semantic information present.

Applying modern design principles provides a modular overall architecture based on functional blocks. Edge devices or servers collect data, normalize them, and provide data flow mechanisms for bulk as well as for transactional data. Serverless computing allows you to focus on working with data instead of infrastructure. Storage components ensure the ability to store structured, highly relational data, as well as to work with unstructured data.

Special emphasis goes to time series transactional data, which are essential in OT systems. Therefore, specific solutions are extensively used to store, evaluate and analyze high volume time series data.

Analytics is a separate module that uses real-time and stored data. Keep in mind that while small- and medium- sized datasets can be processed using standard IT solutions like SQL databases, big data is clearly a domain where specific solutions such as Databricks, Hadoop, and Spark play an important role. Machine learning (ML) components are also an integral part of the analytics layer and AI is fast becoming a major disruptor in digital transformation. AI and ML based applications can provide great results in areas where standard mathematical and physics models fail, for example, in predicting equipment failure and creating complex models of distributed sets of assets.

Finally, visualization and user interfaces connect to databases and analytic engines to provide presentation and interaction capabilities. The OT world knows this as a human-machine interface (HMI) and the IT world calls it a user interface (UI).

Web-based technologies are essential in mobile access, with elements of business intelligence (BI) in place. Typically, customizable tools such as Microsoft's PowerBI business analytics service

are heavily used for visualizations. Using a variety of tools in the ABB integration platform, content can be visualized and organized according to specific needs in very flexible ways. Moreover, near real-time visualizations with refresh rates counted in seconds can complement the more static visualizations in PowerBI, where refresh rates are typically counted in minutes.

The true value of any infrastructure lies in the business benefits the data can generate. With the domain expertise of ABB, you obtain immediate benefits through ready solutions like asset management, energy optimization and various bespoke solutions for domain-specific problems. Asset management solutions can be deployed for critical assets from day one, with more assets added over time. As more data is collected, more advanced and accurate AI-based asset models can be developed. Benefits include improved asset availability, reduced maintenance costs and increased asset lifetime. Another example is energy production, where ready solutions can minimize production costs, reduce losses and improve energy availability. Again, models improve as more data is added, maximizing business benefits over time. The ready solutions also support the phased implementation approach described earlier in Figure 6, as investments in the infrastructure will generate positive business value immediately.

Figure 8. Best practice architecture blueprint

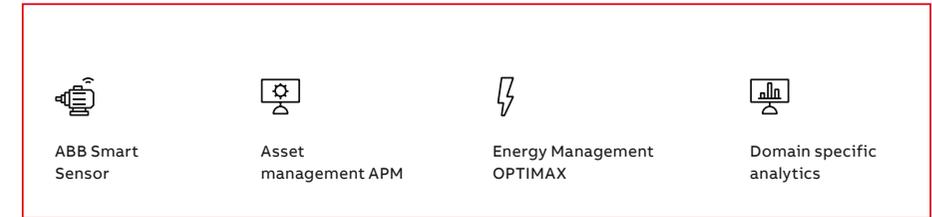
User experiences



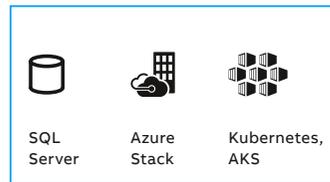
Enterprise business processes



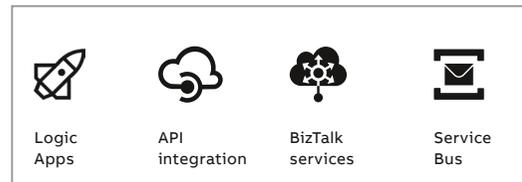
ABB and other SaaS applications



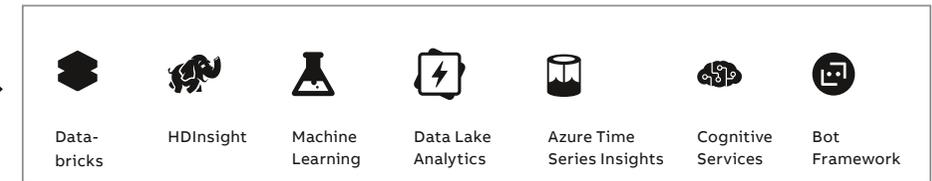
Enterprise IT



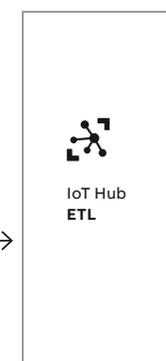
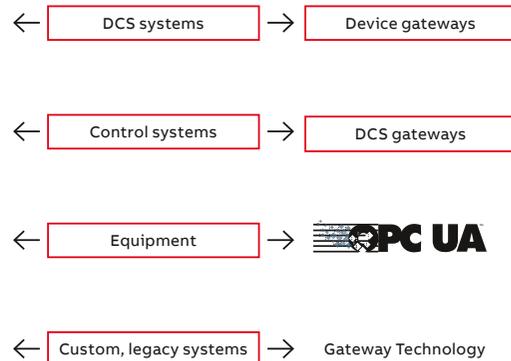
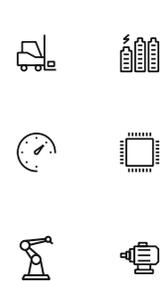
Business integration



Analytics and artificial intelligence



Operations Technology (OT)



Hot path analytics and application platform



Cold path analytics and storage



Governance and cyber security



— ABB components and solutions delivered and build on on top of Microsoft platform services

— Can be supplied in part or fully by ABB+Microsoft as consultancy, engineering and/or managed services. Form a part of the customer IT landscape based on best practices

— Typically part of the customer managed IT infrastructure. Can be supplied or supported by Microsoft

Build your transformation ecosystem with ABB and Microsoft

Selecting the central partners in your ecosystem is a crucial step in ensuring the success of your digital transformation initiative. Finding reliable partners able to handle low-level interfaces all the way up to cloud solutions, combined with process domain understanding may be a make-or-break challenge for businesses embarking on a digital journey.

The partnership formed between ABB and Microsoft (Figure 9) is a game changer for organizations seeking seamless support for a transition to digital operations. The combined strength and expertise of ABB’s domain technologies and Microsoft’s computing technologies is a force

multiplier to help customers address challenges at the source, edge and cloud levels to realize best-in-class benefits.

ABB is a pioneering technology leader in digital industries, offering deep industry domain expertise and a leading digital portfolio for industrial equipment, automation systems, data integration, digital services and industrial data analytics. ABB provides secure, end-to-end digital solutions for all lifecycles through its ABB Ability™ platform. Based on the Microsoft Azure cloud computing service, the platform supports solutions for on-premises, cloud and hybrid cloud uses. The ABB Ability™ digital portfolio enables customers

Figure 9. ABB and Microsoft combine unparalleled domain and IT expertise





to sense, analyze and act to control and optimize individual equipment and processes across vendors and business operations across plants, enterprise and the entire value chain.

Microsoft is the global leader for IT technology and software applications, offering a leading digital infrastructure and portfolio for cloud platform, mixed reality, business applications, business analytics, artificial intelligence and cybersecurity. The breadth of Microsoft's

technology fully supports the integration of both industrial IT and OT related services with any other type of business IT solutions and services.

The partnership between ABB and Microsoft leverages the best of both worlds. As central ecosystem partners we bring a wealth of knowledge and a broad set of solutions to address your needs and to help you navigate the digital journey toward business transformation.



ABB Inc.

3055 Orchard Drive
San Jose, CA 95134
USA

new.abb.com/abb-ability/

Microsoft

One Microsoft Way
Redmond, WA 98052
USA