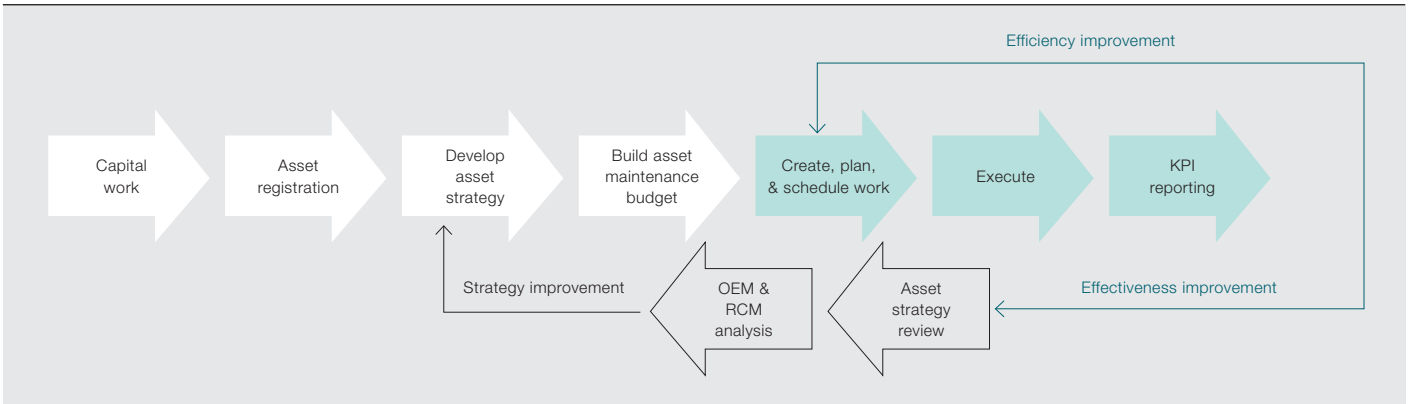
Picture of health

An integrated approach to asset health management

KAREN SMILEY, SHAKEEL MAHATE, PAUL WOOD, PAUL BOWER, MARTIN NAEDELE – Asset-intensive industries face increasing pressure to improve how well they utilize and maintain their equipment. Asset health management is emerging as a critical business process due to the potentially very significant bottom-line impact of asset decisions on profitability, compliance and customer satisfaction. To guide better-informed decisions and eliminate wasteful expenses, ABB's Asset Health Center (AHC) blends business intelligence and asset analytics, incorporating expert knowledge of industrial equipment and verticals. ABB is now leveraging its expertise in power transmission to help a large North American utility optimize capital expenditures, and operations and maintenance plans. A new Subject Matter Expert (SME) Workbench will further expand these analytics and extend asset health management capabilities to other areas.

1 The asset management life cycle



An asset is a physical, capital-intensive resource with a life cycle and, unavoidably, costs → 1. In asset-intensive industries, managing assets well is critical to business success. Due to increasing concerns such as aging infrastructure, financial pressures, regulatory concerns and loss of workforce skills through retirement, traditional asset maintenance strategies relying solely on reactive-based or schedule-based actions no longer meet the business objectives of many of ABB's industrial customers. Asset decisions generally affect many business processes, so decision makers must consider multiple planning horizons and must trade off one set of objectives against another. Knowledge-based asset analytics can characterize the effect of various decision alternatives in terms of their impact on the enterprise performance indicators that matter.

However, asset knowledge is often spread throughout an organization and among its service providers, and may be "stored" on engineers' desks, laptops and desktops in word-processing documents, spreadsheets, flowchart diagrams, etc. Capturing this knowledge and making it usable in enterprise asset analytics is a key challenge.

Multiple sources of asset data

Asset analytics can combine traditional asset health records with operational performance data, asset registry metadata and data from sensors, tests and inspections. As systems grow more complex and numerous, these data volumes become greater. Asset health data may be trapped, unutilized in conventional offline or paper records, or live data streams from smart assets may be lost due to poor storage. Often, data is stored in databases from different vendors and these systems may even use different ways to uniquely identify the same asset.

These data and analysis challenges are solvable by combining careful thought, instrumentation, data interchange and innovation. In some regions of the world, utilities are vigorously driving the deployment of asset health sensors in their equipment to increase visibility into asset performance. However, data processing and analytics that exploit the data a customer already has can jump-start asset health management. For instance, islanded data can be imported or asset data can be extracted by scanning and processing offline records.

Acting on asset data

Apart from the challenge of collecting and integrating all the available asset data, there is also the challenge of knowing what then is to be done for each asset throughout its life cycle. Asset analytics that leverage subject matter expertise enable businesses to capitalize on predictive, condition-based maintenance strategies. Corrective maintenance may, in some cases, be the best choice, but without the right tools in place, and integrated with each other, businesses cannot make the most effective asset decisions. To achieve optimal results, customers need actionable insights into how their asset operations and maintenance decisions and plans might impact their objectives over time. The ABB Asset Health Center (AHC) is designed to surmount the challenges in providing those critical insights.

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Asset Health Center

The AHC's goal is to capture and aggregate data, draw insights and provide decision support in order to achieve a broad range of economic and noneconomic benefits → 2. AHC is based on ABB's FocalPoint business intelligence (BI) platform.

Title picture
ABB's Asset Health Center provides customers with the actionable insights they need to make and execute decisions on asset operations and maintenance that are optimal for their businesses.

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2 Asset integration drivers (GTM Research, 2013) [1]

Type of driver	Driver	Reason
Economic	Reliability	Reduce exposure to regulatory penalties
		Reduce unplanned service disruptions
		Reduce the impact of changing workforce demographics
		Extend asset life and reduce downtime
	Workforce efficiency	Support decision-making for maintenance prioritization
		Improve scheduling of maintenance crews
		Automation of analysis process reduces labor cost
	Risk management	Reduce exposure to catastrophic failures and their collateral damage
	Optimize asset utilization	Improve awareness of asset condition to enable dynamic stressing
Noneconomic	Executing compliance and reporting	Reduce time required to create reports on performance
		Formalize asset evaluation, monitoring and procurement processes
	Networking infrastructure	Reductions in the cost of communications and technological advancements have made communicating with remote, isolated sensors far cheaper and more readily available.
	Data acquisition and processing power	Increases in the number of digital monitoring and control devices in the industrial and utility industries are creating a prodigious stream of data that can be processed at a fraction of the cost due to distributed computing and the drastic reduction in hardware costs.
	Increased enterprise integration	Operational silos continue to converge as integration between various systems and groups within asset-intensive corporations continues to increase as these organizations attempt to leverage data from across the enterprise to gain efficiencies.

The FocalPoint platform has always provided customers with industry-specific data analysis and visualization so it forms a good foundation to deliver asset analytics to the asset-intensive industries ABB serves. Using the platform's capabilities to integrate data from multiple, disparate systems provides a comprehensive view of each asset. In particular, bringing together data from traditional IT systems (such as an enterprise asset management program or a mobile inspection tool) and systems such as SCADA or a specialized sensor network, and analyzing this data in a holistic manner, will unlock new possibilities for assessing risk and supporting decisions on asset maintenance or replacements.

The AHC combines IT/OT (operational technology) integration and analytics with dashboards, such as in the asset monitor ➔ 3, and domain-relevant visualizations to provide insights to planners, decision makers and executives.

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Benefits of the AHC

The four components of the AHC complement each other ➔ 4. Asset master data, and asset performance and condition data, are provided as input to the analyses; outputs of condition diagnosis, recommendations and criticality are visualized; based on the results from asset decision support analyses, decisions are made and service actions are triggered; and the service actions lead to updated asset information.

Within its analytics fabric, the AHC executes the asset-specific diagnosis, criticality and optimization modules. The algorithms that form the core of these modules were developed by ABB's experts in transformers and circuit breakers in power transmission and distribution grids.

3 The AHC asset monitor provides easy-to-interpret insights into risk and consequence of failure across an asset portfolio, such as this fleet of transformers.

Asset health analysis data can be leveraged throughout the enterprise. Indeed, a comprehensive approach to better asset management complements generic BI toolkits by exploiting the knowledge of such asset and domain experts.

Leveraging asset expertise in analytics

Subject matter experts (SMEs) understand how a complex system is put together, its characteristics and tradeoffs, the key engineering design decisions, the environments in which the asset may operate and how maintenance updates or events can impact the health of an asset or system. SME knowledge is leveraged in many types of industry-relevant asset analytics, for instance:

- Asset condition: Asset performance models characterize the health or condition of assets. This includes quantifying the likelihood of failure or degraded performance, identifying likely causes of particular conditions and recommending improvement actions.
- Asset importance: Asset criticality models describe the importance of the asset by characterizing the impact of changes in asset condition on the performance of the industrial enterprise. This includes impact on operations, impact of restoration activities and interdependencies with other assets.
- Asset decision support: Asset decision support analyses combine knowledge and data to deliver effective guidance on asset-related decisions.

As an example, a useful decision support analysis for a regional power transmission company may consider total risk of failure – combining health and criticality information – to determine the optimal overall capital expenditure budgets and operations and maintenance plans for each of the next two years.

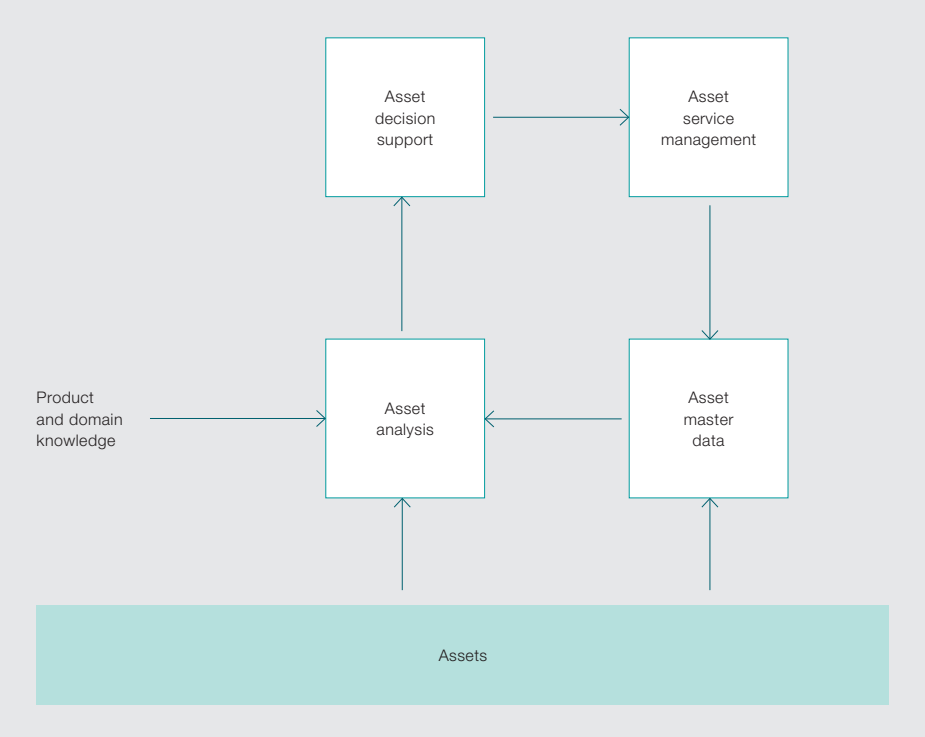
Speeding up creation of analytics by asset experts

Making it as easy as possible for asset experts to convert their asset and domain knowledge into executable software system modules is crucial. Three actions are key to this:

- Embed ABB expert knowledge in the software for the wide variety of equipment and systems that ABB provides.

The SME Workbench supports asset analytics across multiple industrial verticals with a common development tool and enables asset, data and performance experts to focus on what they know best.

4 The ABB Asset Health Center integrates all components needed for comprehensive asset management.



– Capture customer asset performance models to complement the ABB subject matter expertise ("end-user programming").
– Enable third parties (eg, other vendors or expert consultants) to contribute complex asset diagnosis modules via an application programming interface (API).

The SME Workbench was created to meet these three requirements and satisfy this goal. It supports asset analytics across multiple industrial sectors with a common development tool and enables asset, data and performance experts to focus on what they know best.

Freeing asset experts to focus on knowledge

The SME Workbench enables the asset expert to build algorithms without the need to know how data is fetched or stored and frees them from understanding how the algorithms will execute in an enterprise environment. Asset SMEs can now naturally describe their expertise using visual editors such as flowcharts, decision trees and other familiar tools.

As a team of SMEs collaborates to build an asset performance model, the artifacts of the model are stored in a cloud repository, while the SME Workbench provides infrastructure to test the analytic model locally.

Benefits of the SME Workbench

The SME Workbench enables anyone with asset expertise to quickly develop new analytic model plugins. The visual drag-and-drop interface helps asset experts to quickly convert their ideas and algorithms into high-performance software modules. Customized toolboxes provide SMEs with easy access to the calculations and reliability analysis functions that are most relevant for asset analytics. In addition to enabling SMEs to efficiently share their knowledge, the SME Workbench can be extended with new editors tailored to streamline development of asset analytics for different domains.

The SME Workbench and APIs allow customers and third parties, including non-ABB asset vendors, to contribute analytics that can be seamlessly integrated into the AHC analytics structure. This approach allows the capture and dissemination of knowledge that can be spread throughout the organization.

Reuse and extensions to new domains

The initial ABB AHC customers are power utilities, so the first asset diagnosis analytics have been oriented toward

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power grid equipment. A benefit of the AHC architecture is that the BI platform and SME Workbench are domain-independent. ABB has strong domain knowledge in many asset-intensive industry verticals, such as oil and gas, water, mining and marine. This asset health offering will be extended to these other industries as ABB's asset and domain experts use the SME Workbench to contribute their knowledge.

The Internet of smart assets

ABB's vision for the future of asset health management is based on a system that integrates information about the asset with diagnostic expertise, presentation of actionable information and support for executing those actions. ABB can, for this purpose, integrate asset diagnostics and analytics developed by experts with its portfolio of powerful and proven applications that cover:

- Enterprise asset management in capital-intensive industries
- Asset information visualization and drill-down
- Service crew scheduling and task support

Analytics, dashboards, visualizations and the ability to ask questions and get meaningful answers are all necessary, but not sufficient. Assets with health sensors and networking capabilities will become more and more common, while asset designs and knowledge will continue to evolve. The AHC supports a closed-loop solution that can predict asset performance and that can help optimize operation and maintenance, expenses and capital investments. The AHC drives asset performance and optimizes business results by continuously capturing information from an array of smart assets, systems and sensors, which the advanced analytics engine processes to extract actionable insight.

Asset health management is emerging as an increasingly critical business process because it impacts the bottom line of customers. ABB is moving forward with an integrated AHC that combines business intelligence and analytics. By using the SME Workbench to facilitate analytics development and integration, expertise can be captured and applied to provide better decision guidance to asset-intensive industries. ABB is now fulfilling a contract to deliver this AHC solution to the largest transmission equipment owner in North America. By streamlining capture and use of subject matter expertise, more knowledge can be leveraged to further enhance the analytics and to apply the solution to other verticals.

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