Energy Management and Asset Supervision through ABB Digital Solutions

Mazin Abdalla
Safety and COVID-19

Avoid close contact with people, such as shaking hands.

Ensure there is a sufficient distance between individuals (two meters), especially in confined spaces.

Stay at home / alert
Agenda
Energy Management and Asset Supervision through ABB Digital Solutions

20’ | ABB energy management

15’ | ABB asset supervision

5’ | ABB Ability™ electrification solutions

10’ | Live ABB Ability™ dashboard walkthrough experience

10’ Q&A
Digital transformation: ABB Electrification Strategy

Safe
Protection and Control everywhere, from anywhere on every device

Smart
No need for engineering, moving your business to Software as a Services model

Sustainable
A plug and play solution for ABB Equipment
Global growth drivers require more reliability

- **Urbanization**
  - +2 billion people living in cities (+1 billion world population)

- **Shift to electricity**
  - +50% increase
  - Ensuring better energy mix to ensure sustainable availability
  - Energy efficiency means more comfortable lives and lower energy bills

- **Data and digitalization**
  - 7.5 x increase
  - Demand to translate such valuable data into actionable insights towards higher efficiency, reliability and safety

Source: International Energy Agency, 2018
Energy Efficiency Report 2019
Energy Security Report 2018
Energy Management aim at monitoring, controlling, and optimizing the performance of a facility in order to reduce the energy consumption and increase the overall efficiency and productivity.
Energy Trilemma

Multi-tiered energy management solutions required to help customers manage the “energy trilemma”

Providing visibility, advanced analytics and optimizing power supply and demand

- **Smart devices**: Device level monitoring & control
- **System monitoring**: Local / remote system monitoring, analytics & reporting
- **Site optimization**: Real time optimization & coordinated control of multiple resources at site level
- **Market optimization**: Forecasting, aggregating & trading flexibilities

Energy Cost reduced up to 20%
Towards Energy Efficiency

1. Measure and audit consumption
2. Install low consumption devices, power factor correction
3. Optimize through controlling
4. Forecast and predict your facility behaviors

Achieve up to 20% Energy Efficiency
## Energy Inefficiency Factors

“Energy management can be seen as important instruments to recognise and observe existing economic energy efficiency potentials by systematic procedures to gain knowledge and developing a strategy to achieve energy efficiency targets.”

“The Energy Efficiency Directive 2012/27/EU (EED) establish promotion of energy efficiency in order to ensure the achievement 20% target on energy efficiency and to pave the way for further energy efficiency improvements”

### Relevant British standards

- BS 7671:2018 – Draft New Part 8, Section 801
- Energy Efficiency response to IEC 60364-8-801
- ISO 50001, BREEAM

1 Source: Energy Efficiency Trends and Policies in Industry, EU Commission

### Example based on ABB experience

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Main reason</th>
<th>Impact on Energy Bill (incl. penalties)</th>
<th>Impact on Opex</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC</td>
<td>Pilot or ignition problems</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Blown fuses or tripped breakers</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Drives</td>
<td>Harmonics</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Pilot or ignition problems</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
<th>Impact on Energy Bill</th>
<th>Impact on Opex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Factor</td>
<td>&lt; 0.95</td>
<td>High</td>
</tr>
<tr>
<td>Power Quality</td>
<td>Harmonics, Sags</td>
<td>High</td>
</tr>
<tr>
<td>Peak Monitor</td>
<td>Peak above contractual power</td>
<td>High</td>
</tr>
</tbody>
</table>
Optimize energy bill
Reduce hidden costs and manage unpredictable peaks of energy

20%
Energy saving with predict power consumption
Data mining used to predict power consumption helps facility manager to reduce energy used up to 20%.

6%
Electricity bill saving with prediction of PV generation and consumption
Prediction of consumption and PV generation bring to reduction of 6% of electricity costs.

Power factor – Typically caused by large amount of motors. Identify the part of the plant that use majority of the motors and we measure it, and implement a corrective capacitor bank or take other corrective actions.

Harmonics – Produced by inverters, DC converters, Switch mode power supplies, AC or DC motor drives, variable speed drives. They are typically used to improve the efficiency but we also need to take care of power quality – Poor power quality can cause malfunction of machines and devices.

Compare similar production lines, even if they are in different sites
Review utilities contract based on your specific energy demand

Sources
https://www.eia.gov/consumption/commercial/reports/2012/energyusage/
https://www.gminsights.com/industry-analysis/distributed-solar-pv-market
Avoid energy waste
Be sustainable, don’t waste your energy

38%
Energy consumption
Industry is responsible for around 38% of global final energy consumption

24%
Carbon emissions
24% of the world’s total CO2 emissions are due to industry sector

Plan for sustainability, reach your Mission to Zero

Our planet worth, be sustainable means being able to use and control the correct mix of energy sources, more reliable, more sustainable.

- Unexpected consumption can be identified based on alerts and thresholds, in realtime.
- Take under control you renewable sources, like PV. Compare generation with consumption.
- Motors are high energy consumption load in industrial application, define a baseline and take consumption under control for each single motors and identify immediately bad working situation generated by usage or other cause. Upgrade plant and save up to 10% of power consumption.*
- Peak shaving can bring to reduction of peak demand of 18% and increase of peak-off demand of 12%.

https://www.iea.org/digital/

* According to a study from the US Department of Energy. Main contributor is upgrade of fixed speed motors to frequency control.
Cost allocation

Bind consumption to each specific product line, production process or subprocess.

Put submeters by department or production line or process and allocate energy cost to encourage energy efficiency behaviors.

Logical groups aggregate the consumption or the generation of more than one equipment, panel, loads. With logical group you can take under control a specific part of the process, crossing the border of the single production line or floor. You can group all the loads on a specific production line and calculate the total energy consumption.

Cost widget show the real consumption based on the Utilities tariffs, compare in real-time the billing information with the measured information.

Energy consumption is a huge cost of production, How to understand who is consuming and charge back according to it.
ABB Grid Integration solutions help to balance the demand created by new electricity consumers entering ports with traditional and renewable power generation by enabling a stronger, smarter and greener port grid.

Patrick Fragman
Managing Director, ABB, Power Grid, Grid Integration

Customer needs
Set sustainability targets that require significant advances in energy efficiency. More precise monitoring of the power consumed in every part of its operations is key.

Digital offering
ABB Ability™ Energy Management Solution
➢ Peak Monitoring
➢ Cost Planning
➢ Energy Audit

“ABB’s digital solution comprehensively monitors our energy consumption. Combining Energy Management Solution with ABB’s circuit monitoring system means we can track all our consumption, right down to the building’s lighting.”

✓ Low-voltage distribution boards
✓ Emax 2 circuit breakers, Tmax T4 and T5 molded case circuit breakers
✓ CMS-700 circuit monitoring sensors
✓ ROI 2 years
ROI: case of a F&B small plant

Energy management on existing LV switchgear and sub-distribution

Information about Energy Bill:
- Contractual Power Installed = 400 Kw
- Avg Energy Consumption = 133 MWh / month
- Avg Energy Bill = $32 k / month ($384k / year)
- Avg Energy price = $0,24 / Kwh
- No Energy Management system installed

Information about ABB standard devices installed (20 devices):
- 2 main breakers (Emax 2)
- 8 breakers (XT2, XT4)
- 1 control Unit with 96 sensors (CMS-700)
- 9 power meters (M4M)

Information on digital investment:
- Digital equipment (gateway and connectivity modules) + commissioning = $2,5 k
- Replacements of drives and installation of capacitor bank = $15 k
- Yearly Standard subscription for ABB Ability Energy Management = $ 660 /y
- Yearly Premium Intelligent Alert on Cost Control for ABB Ability EM = $ 690 /y

Features utilized
Grouping, alerting and scheduled reporting

ROI = 2,2y

Peak Monitoring, Cost Control and Alerting

Energy Savings = $19 k / Year
Asset Supervision
Global growth drivers require more reliability

Data and digitalization

7.5x

Demand to translate such valuable data into actionable insights towards higher efficiency, reliability and safety

Experienced workforce

-50%

Utilities experienced workforce will retire by 2025

Health, Safety, Environment

+47%

Direct and indirect costs of workplace injuries with increased compliance cost
How digitalization helps electrification reliability and power availability

Asset performance management (APM) systems act to improve the reliability and availability of physical assets while minimizing risk and operating costs.

- **Keep production up and running**
  Mega-trends are challenging industries to get higher availability, sustainability, and flexibility.

- **Installed base**
  Getting older, so with higher risks in terms of safety, flexibility, scalability and security.

- **Optimize maintenance**
  Decreasing maintenance budgets, higher system complexity and quicker troubleshooting.

- **Risk of failure**
  Direct and indirect costs, getting higher nowadays due to reasons above.
Risk of failure (RoF)

Asset managers, facility managers, maintenance managers apply (maintenance and asset life cycle) strategies to keep under control the risk of failure. It is made of two factors: consequence of failure (CoF) and probability of failure (PoF).

Example in the risk map:
Asset (1) and (4) have same level of criticality but different health condition. (4) needs to be addressed first.

Asset (2) and (3) have same health condition, but different critical level. (3) needs to be addressed first.

Risk (RoF) = Probability (PoF) x Consequence (CoF)
Consequence of failure

It is the severity of the consequences of failure.

It can go from “negligible”, like a spare feeder, up to “catastrophic”, like a main incomer - which might include matters such as loss of life and injury to persons.

Type of Consequences:
- Physical (e.g. assets disruption)
- Financial (e.g. increased costs, loss of production)
- Legal (e.g. fines, penalties)
- Social/psychological/community

1) A 1999 Electric Power Research Institute (EPRI) study pegged total direct and indirect costs of an arc flash incident
2) News.thomasnet.com/company story/downtime-costs-auto-industry-22k-minute-survey-48107
3) Cost of Data Center Outages, Ponemon Institute
4) The Economic Impact of August 2003 Blackout done by ELCON
Maintenance strategy

To keep under control the probability of failure of an asset, different maintenance strategies are available:

- **Corrective maintenance**, or run-to-failure: do maintenance only when problems occur.
- **Preventive maintenance** regularly scheduled, using either time intervals, or usage (operations/cycle count) as a trigger. It can be enhanced with root-cause analysis and troubleshooting instructions (proactive).
- **Condition-based maintenance**, is a preventive maintenance supported by condition monitoring of the asset, with basic diagnosis on read values.
- **Predictive maintenance**, combines various sensor readings (condition monitoring), sometimes external data sources and performs powerful analytics on thousands of logged events/data (e.g. simulation, statistical analysis, etc.). It can be enhanced further adding prescriptions to support the mitigation actions.

<table>
<thead>
<tr>
<th>Maintenance strategy</th>
<th>Direct costs (maintenance and spares)</th>
<th>Indirect costs (consequence of failure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrective maintenance</td>
<td>No maintenance, just CAPEX to restore at failure</td>
<td>Probability of failure not under control. Highest risk of production/service loss</td>
</tr>
<tr>
<td>Time-based maintenance</td>
<td>High maintenance costs, due to recurring equipment inspections</td>
<td>Probability of failure under control just after the recurrent inspections</td>
</tr>
<tr>
<td>Condition-based maintenance</td>
<td>Less maintenance costs due to reduced inspections</td>
<td>24/7 monitoring of data correlated to relevant potential failure causes</td>
</tr>
<tr>
<td>Predictive maintenance</td>
<td>Lowest maintenance costs only when required</td>
<td>Continuous prediction of probability of failure and remaining life</td>
</tr>
</tbody>
</table>
Predictive maintenance

Preventive maintenance (time-based)
It assumes that the probability of equipment failure increases with use, which is not often the case (usually there is a random pattern¹). Every asset has a maintenance plan, based on manufacturer instructions or experience.

Predictive maintenance
It is based on condition monitoring data to predict failure. Maintenance when (date) and where (asset) required. It can go also further by combining multiple variables with analytics to predict failure with a higher degree of confidence and fewer false positives.

¹ Source NASA and US Navy: 18% of failures are age related, and 82% have a random pattern. So, preventive maintenance (PM) provides a benefit for just 18% of assets.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Maintenance</th>
<th>Frequency</th>
<th>Time/ asset</th>
<th>Predictive</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV circuit breaker</td>
<td>Visual/B</td>
<td>2 years</td>
<td>2 h</td>
<td>0 h</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>5 years</td>
<td>2 h</td>
<td>1.4 h</td>
</tr>
<tr>
<td>MV/LV switchgear</td>
<td>Visual</td>
<td>0.5 years</td>
<td>0.5 h</td>
<td>0 h</td>
</tr>
<tr>
<td></td>
<td>Basic</td>
<td>5 years</td>
<td>0.75 h</td>
<td>0 h</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>10 years</td>
<td>2.5 h</td>
<td>1.75 h</td>
</tr>
<tr>
<td>Low Voltage Motor</td>
<td>Basic</td>
<td>1 year</td>
<td>1 h</td>
<td>0.25 h</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>1 year</td>
<td>4 h</td>
<td>0 h</td>
</tr>
</tbody>
</table>

Example based on ABB experience

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Predictive Cost Reduction (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV circuit breaker</td>
<td>USD 168/y vs USD 336/y</td>
</tr>
<tr>
<td>MV/LV switchgear</td>
<td>USD 113/y vs USD 250/y</td>
</tr>
</tbody>
</table>

100% PREDICTION AVOID HIGH COSTLY UNPLANNED LABOR
30% DECREASE MAINTENANCE TIME
40% OPEX COST REDUCTION
Monitoring main electrical failure causes

An efficient and effective condition monitoring solution focuses on most important failure causes.

Sensors and other data sources support the potential failure causes monitoring, substituting the usual manual time-based inspection and maintenance.

A diagnostic algorithm typically is required to highlight an abnormal condition (e.g. a temperature over a threshold), which could lead to a potential failure.
Running predictive maintenance

Why?
Predictive maintenance provides benefits that improve the bottom line, with a focus on maintenance and retrofit cost optimization. It is not just cost effective maintenance with maintenance based on best predicted scenario, but also full visibility on assets risk analysis, used to prioritize remedial actions. Accurate prediction saves from costly breakdowns.

How?
Predictive maintenance is based on predictive analytics, which exploits collected data with offline assessment and/or online condition monitoring. Typical calculated outputs are probability of failure within a year, remaining useful life, service prescriptions, and risk map analysis.

Asset condition data collection
Relevant electrification assets in the plant can be monitored to track condition. Raw and calculated data can be predictive analytics.

ABB Ability™: gain insights on assets
ABB Ability solutions offers asset health dashboard, and predictive analysis to optimize maintenance and improve availability, reliability.

Assets  Condition  Prediction  Savings

Other edge/hybrid system
Condition assessment
Condition monitoring and smart sensors

Fleet and asset health monitoring, including probability of failure and remaining useful life
Notifications and Prescriptions suggesting and planning service remedial actions

©ABB
Predictive maintenance journey

Here is a typical journey of a user using ABB Ability asset management solution:

1) Remote supervision of the facilities (multi-site): owner or service provider can take action everywhere, anytime.

2) ABB Ability™ enables a digital twin of the electrical system. Ease of use: interactive images through tags & markers.

3) Asset health overview with alerts management to react quickly, reduce downtime and plan maintenance when suggested.

4) Asset details with operational and maintenance information to implement predictive based maintenance.
ABB Ability™ Asset Management

Why?

ABB Ability™ enables a digital twin of the electrical system, with health information and maintenance planning (prediction).

- **Remote supervision of the facility** (multi-site): owner or service provider can take action everywhere, anytime.
- **Ease of use**: interactive images through tags & markers.
- **Alerts management**: reduce downtime and service planning

Plant and asset health conditions

Digital twin of each component

Next maintenance plans
ABB Grid Integration solutions help to balance the demand created by new electricity consumers entering ports with traditional and renewable power generation by enabling a stronger, smarter and greener port grid.

Patrick Fragman
Managing Director, ABB, Power Grid, Grid Integration

Plant
Consortio di Bonifica Veronese, wine yard

Customer needs
Remote monitoring of water pumping stations.
Optimization of personnel’s tasks and costs, and downtime prevention.
Removal of power quality penalties.

Digital offering
ABB Ability™ energy and asset management solution, Emax 2

With ABB solution we had a payback of less than 3 months, 30% savings on annual operating costs. The system sends alerts to prevent downtimes, optimized personnel travels and service activities.

✓ With Ability EDCS avoid power quality penalties with the integrated analysis.
✓ With Ability EDCS Avoid external energy audit, with embedded reporting.
Predictive maintenance on existing MV switchgear (20 panels/breakers)

Historical information about failure avoidance savings:
- Avg CoF, caused by MV switchgear\(^1\) (partial production loss + restoration) = $50K / h
- Avg downtime in last 10 years due MV switchgear = 0,2h/y (avg costs = $10k/y)
- Savings using predictive analytics (70% monitorable failure causes) = $7K/y

Historical information about maintenance savings:
- Average time-based maintenance costs = $8k/y
- Average predictive maintenance costs = $4k/y

Information about smart equipment, sensors and analytics costs:
- Digital equipment (condition monitoring, sensors\(^2\)) + commissioning = $16k
- Yearly subscription for predictive analytics = $1,6k/y

\(^1\) One failure 5 years ago interrupted unexpectedly partly the production for 2h
\(^2\) Includes: circuit breaker mechanical and electrical monitoring, environmental condition monitoring and switchgear main joints thermal monitoring.

**ROI: case of a manufacturing plant**

<table>
<thead>
<tr>
<th>Year</th>
<th>Failure avoidance savings</th>
<th>Predictive maintenance savings</th>
<th>OPEX (predictive analytics subscription)</th>
<th>CAPEX (condition monitoring)</th>
<th>ROI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-16,000</td>
<td>0</td>
<td>-8,000</td>
<td>8,000</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>-8,000</td>
<td>0</td>
<td>-8,000</td>
<td>8,000</td>
<td>-1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>-8,000</td>
<td>8,000</td>
<td>-2</td>
</tr>
<tr>
<td>3</td>
<td>8,000</td>
<td>0</td>
<td>-8,000</td>
<td>8,000</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>16,000</td>
<td>0</td>
<td>-8,000</td>
<td>8,000</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>24,000</td>
<td>0</td>
<td>-8,000</td>
<td>8,000</td>
<td>0</td>
</tr>
</tbody>
</table>

ROI = 1,6y
ABB Ability™ electrification solutions
ABB Ability™ Electrification Common Platform

Combined solution offering to deliver customer value

**Automation & Security**
- Emergency lighting & access control
- Sensing & metering
- Distribution, protection connection
- Lighting & shading control
- HVAC control

**Digital Services**
- Energy Management
- Asset Management
- Building Management

**Power supply**
- EV charging

*EDCS-Electrical Distribution control system
#MRC- My remote care
**ABB Ability™ Electrification Solutions**

Technical Electrical and Communication architecture

- **MEDIUM VOLTAGE SWITCH GEAR**
  - Relay
  - Monitoring and Diagnostic
- **LOW VOLTAGE SWITCHBOARD**
  - Circuit Breakers
  - Switches
  - Retrofit Kit
  - MCC
  - POWER PANELBOARD
  - DRIVES, MOTORS AND MECHANICAL (typically cloud connection via mobile network, due to location)
- **ON-SITE ASSET HEALTH**
  - IEC 61850 MODBUS (over TCP)
  - Circuit Breakers
  - Switch Fuse Disconnectors
  - Power Quality Meters
- **ON PREMISE**
  - WEB API
  - CLOUD/MULTISITE
  - ABB Ability™ Energy and Asset Management
- **WEB API**
  - On-Site Asset Health
  - IEC 61850 MODBUS (over TCP)
- **EMBEDDED**
  - External
  - Internal
  - Electrical Feeder Meters
  - Non Electrical Meters
  - DRIVES, MOTORS AND MECHANICAL (typically cloud connection via mobile network, due to location)

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ERP - 3rd party system
Business intelligence

**June 3, 2020**

**Slide 31**
ABB Ability™
Electrification Solution

Why?
Customers want to increase awareness on owned resources, improve performance and optimize their assets to reduce total operating costs.

How?
ABB Ability™ Energy Management Solution simplifies building management, offers predictive capabilities that reduce downtime and maintenance, and enables users to dramatically reduce operational costs.

25% Space savings
Space saving, modularity and flexibility

30% Lower operational costs

Cloud Connected
Monitor and analyze the data to take decisions improving efficiency.

Lower acquisition cost
The embedded intelligence in one single device.
ABB Ability™
Electrification Solution

Why?
Customers want to increase awareness on owned resources, improve performance and optimize their assets to reduce total operating costs.

What?
ABB Ability™ Electrification Solution is a cloud-based energy management and asset supervision solution for buildings and industrial sites.

How?
It helps simplify facilities management, and reduce energy and maintenance bills, enabling a 30% reduction on operating costs.

The power of understanding at your fingertips
New business model for software: from CAPEX to OPEX

**Subscription model**
easy to purchase. Get only what you need, only pay for what you get

**Software as a Service**
no need to implement complex system on premise

**Quick return of investment**
no big investment upfront reduces the payback period
Free Digital solutions throughout 2020
Helping customer achieve operational stability & savings during COVID-19 crisis

Waiving charges for ABB Electrification Software-as-Service solutions for 12 months - as a sign of our commitment to resilience over the difficult times

Leveraging ABB Ability Marketplace™
Live ABB Ability™ dashboard walkthrough experience
Summary
ENERGY MANAGEMENT

• Optimize energy bill:
Evaluate the best energy tariff based on your consumption profile, avoid overcommitment from the utilities with load shifting, peak shaving and power control.

• Avoid energy waste:
Identify unexpected consumptions and eliminate unwanted energy usage

• Cost allocation:
Calculate appropriate energy cost allocation over different cost centers.

ASSET SUPERVISION

• Reduce total cost of ownership:
Optimization of maintenance schedule and increase work force efficiency

• Maximize Uptime:
Avoid unplanned outages which directly effect revenue generation

• Improve safety:
Reducing catastrophic failures which impact human and asset life
Digitalization support from design to service

Digital specialists
Local technical teams, able to consult on how to digitalize the electrification system and apply asset management solutions.

Service centers
Supporting the customer in adoptive predictive maintenance, offering Power Care service agreements with remote support and extended warranty.
Any Questions?