Condition Monitoring for Motors and Powertrain
An introduction
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Taking reliability, availability and efficiency to the next level

The challenges of maintenance operations in the age of Industry 4.0

### Reliability

“We want to minimize unexpected shutdowns and maintain reliability”

- Understand **actual conditions** of assets
- Assess the **risk exposure** to unplanned downtime

### Asset lifespan and availability

“We want to understand and solve problems earlier and faster”

- Access **historic data** and **benchmarks** to optimize conditions
- **Receive alerts** and **predictive analytics** to maintain performance
- **Receive expert advice** and **collaboration** at a click

### Limited resources

“We need to optimize our limited resources”

- **Monitor drives** in **remote** or **restricted locations**
- **Focus maintenance** on **actual requirements**
- **Receive expert advice** and **collaboration** at a click

### “The new normal”

“The global situation has changed and we need to implement remote working as common practice to maintain safety and success of our business”

- **Improve** **health and safety**
- **Ensure** **maintenance and productivity**
- **Secure** **business continuity** in **adverse environment**
Value of Digitalization

Sensor is only a cost if not used
Data as such has only limited value
Data transformed to information increase the value of data

Only when information becomes action maximal value is achieved

To optimize the value of digitalization also organization, processes, work methods and behavior need to be adjusted
An Introduction to Condition Monitoring for Motors and Drives
Why monitor conditions of assets?
Lessons from a real case in the United Kingdom (Motor at a Pumping station)

Imagine that you have a powertrain in dry well with restricted access

**Without sensor**

Nobody ever goes near the assets.
When something fails, you will be surprised, then...
- Pull the spare asset out of your warehouse
- Find an electrician and beg them to come
- Get lifting gear in place
It will take at least a day to replace, even if you have a spare on stock.

Time and cost can easily spiral out of control.

**With Condition Monitoring**

Nobody ever goes near the assets
But customer will get a warning before anything has happened, then ...
- Order a new asset / spare parts
- Plan an intervention.
- Planned engineer visit comes spare
- Run down and run up in an orderly fashion

Without a spare asset on stock, without an electrician on standby.

Allows UK water industry to move from “run to fail” to “proactive maintenance”
Extending to the Powertrain

Motors, drives, bearings and rotating equipment in same UI

Digital Powertrain

Condition Monitoring for Drives
- operating parameters
- Errors, warnings, events
- E-mail notifications
- Drive Benchmarking
- "At the touch of a button" reports
- Daily parameter backup
- Apply state
- wear forecasts

Smart Sensor for Motors
- Vibration
- Temperature surface
- Bearing condition indicators
- Power, speed, frequency
- Operating hours, starts
- Relubrication Note

Smart Sensor for Bearings
- Vibration
- Temperature surface
- Bearing condition indicators

Smart Sensor for General Machinery
- Vibration
- Temperature surface
- operating hours
- ...
Condition Monitoring Digital Powertrain

Service architecture in a nutshell

Customer environment

Connected asset (drive, motor, bearing, pump)

End User

Data storage

Visual data, self-service reports, alerts & Chat (With Assistance option)

Condition Monitoring

Remote Assistance

ABB Motion Services (in Country or International Support centers)

Customer support
Expert support Reports

Full features

3rd party (if applicable)

Selected features

Ad hoc customer support via Voice or Chat

Service Provider

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December 9, 2021 | Slide 7
Customer Case – 2020-05-27
Food and Beverage – Vibrations alarm

What happened:
• The sensor alerted the customer for increased vibrations. Clearly increasing trend that can be seen over a long period.

Action:
• The customer contacted ABB to make an on-site measurement with a hand-held vibration instrument

Consequences and risks:
• An upward trend in this way will put more stress on the machine components over time. Which will lead to more damage and a greater effort may be needed.

Food & Beverage customer - $4,000 per hour downtime
(12 hours downtime common to clean work in progress)
What value does the service deliver?

Peace of mind, health and safety, risk management, optimized maintenance....

Remote Maintenance management

- Web and mobile access with status overview

Convenience

- Analysis reports with maintenance recommendations *

Proactive & predictive Maintenance

- Historian and trends + asset comparisons

Optimized maintenance

- Analysis of outliers and anomalies

Faster response & protection

- Your asset is talking
  - Errors, warnings, events
  - operating limits
  - Individual threshold values
  - parameter changes
  - Remote connection aborted

- Automatic email notifications

Peace of mind

- On-call expertise - your partner ABB
Values of the Digital Powertrain

- **Manage and minimize risks.** Prevent plant downtimes, improve occupational safety, resolve warranty claims and avoid penalties for delays.

- **Eliminate inefficiencies.** Save energy, reduce labour cost, use resources efficiently, manage lack of skills and generational gaps. Optimize along the value-added chain, what to purchase, how to use, when to replace.

- **Optimize investments.** Accurately engineered plants requiring less redundancies and fewer spare parts and run longer.

- **User experience.** Offer people a more satisfying way to do things. Flexible configurable functionality, easily scalable fleets, pay-per-use. Easy to use, easy to share.

- **Disruption/Defence.** Attack competitors by doing things in a different way with less risk, higher efficiency and better user experience. Alternatively, defend against someone doing it to you.
Customer benefits

How does ABB Ability Condition Monitoring for Motor and Powertrain help your business?

ABB Ability Condition Monitoring can help to...

- Reduce downtime by as much as 90%\(^1\)
  - Service or replace an asset before they break down
  - Shift unplanned maintenance to planned outages
- Extend asset lifetime by up to 30% \(^2\)
  - Avoid asset failures by timely servicing
  - Prevent secondary damage by avoiding breakdowns
- Increase energy efficiency by around 10% \(^3\)
  - Create better loading profiles based on energy consumption patterns
  - Rationalize the installed base
- Net working capital — less redundant plant and inventory.
- Risk mitigation — Operational risks, health and safety risks etc.

“\textit{When we reduce 2 unexpected downtime, the monitoring has paid for itself}” - Pulp & Paper

“We have reduced unplanned downtime by a further 20 hours a year”, Mining

“I have reduced asset inspection by 66%”, Chemical

Overall, reduced operation costs, increased profits, fewer accidents, greater compliance to environmental commitments and improved reputation!

Our customers have seen the results: payback within months, sometimes within weeks!

\(^1\) As part of complete care package, vs a “run to fail” strategy, reported by a customer in Australia

\(^2\) Thanks to compliance to maintenance program and proactive action; Smart sensor client, UK;

\(^3\) Measure and recommendations about energy usage, Smart sensor and condition monitoring client, NL.
Energy Efficiency and Digitalization
Use long term data to uncover hidden opportunities
The world keeps evolving...

ENERGY EFFICIENCY CLASSES FOR NEW EQUIPMENT
PARIS AGREEMENT & UN’S SUSTAINABLE DEVELOPMENT GOALS
CONVERTING COMBUSTION ENGINES TO ELECTRICAL
SECURITY CONCERNS IN SHARING DATA
UPCOMING CIRCULAR ECONOMY REGULATIONS
ENERGY WASTE FROM OLD INSTALLATIONS

Change your horizon

... discover the hidden
The Facts
Rising demand

IEA scenario 2008-35

Europe and North America
7.1%  25%

China
98%  210%

India
148%  292%

Latin America
61%  89%

M. East and Africa
66%  128%

Growth in primary energy demand
Growth in electricity demand
Why motor and drive effectiveness matters?
Keeping the world turning, while saving energy every day

Managing electric energy consumption

- 38% by motors in commercial buildings
- 70% by motor systems in industrial applications
- 75% of motors used for pumps, fans, and compressors with substantial efficiency improvement potential
- 25% power reduction when adding a variable speed drive to an existing motor of a pump, fan or compressor

Managing assets across their entire life cycle

Total Cost of Ownership (TCO) = Capital expenditure (CAPEX) + Operational expenditure (OPEX)

- Plan & design
- Procure & build
- Commission
- Operate
- Maintain & modernize
- Decommission
Energy efficiency, a key to succeed in the future...

Paris agreement and UN’s sustainable goals target carbon neutrality

With optimized, high-efficient rotating equipment, global electricity consumption could be reduced by up to 10 percent

Known, regulated and visible

Hidden potential

Improving the efficiency of a 11kW motor by 3% will reduce CO2 emissions by **15.9 tons** over 10 years
ABB Energy Appraisal service
Revealing how much energy you can save and where

Are you wasting energy but you don’t know where to start?
Energy Appraisal service

Traditional method

Walk The Site
- Visual review of installed applications
- You and an ABB-certified engineer walk the site
- Identify a pool of opportunities and target applications

Monitoring, data collection
- Learn more
- Identify target pump, fan and compressor applications
- Collect necessary data from motors, used control methods and site conditions

Data analysis
- An ABB-certified engineer analyzes the data.
- Evaluation of potential savings per application
- Prioritize and report on the opportunity pool based on payback and risks

Recommendations
- We provide an estimate of saving potential, payback time for investment, CO₂ reduction, etc.
- We will prepare an action plan and manage the implementation, if desired
Motors running variable torque loads (pumps & fans)

About 90% of pumps and fans are oversized and running on partial loads.

- These are the target applications to achieve significant energy savings.
- Using the affinity laws, it is easy to calculate the power needed to run the motor at a certain speed.

Example: A pump or fan running at 80% speed consumes as little as 50% of the energy of one running at full speed.

Old Motors with poor Efficiency

By making the decision to use energy efficient motors, you can lower your energy costs and have a positive effect on the environment. ABB's energy efficient motors are designed and labeled to comply with the international IEC standards.

Depending on the application, the achieved efficiency improvement can be significant when the old motor is upgraded to a new one. Remember to follow the local MEPS.

ABB provides easy tools to assess benefits and payback times for changing to new modern motor technology.

The default assumption is, that the motor dimensioning is correctly done. These assessments are focused on finding the optimal devices for the chosen task, not to analyze what the task is (process or system).
Energy Efficiency and Digitalization

Use long term data to uncover hidden opportunities
Two Key Areas to assess motor insights with digitalization

Recognize the long-term trends

- Minimize inefficiencies of your assets
- Condition monitoring of Motors and Drives in same User Interface
- Condition Monitoring and Condition Based Maintenance recommendations.
- Alarms and alerts
- Reports
- Expert & support Services

Discover hidden opportunities

- Earlier it has been too cumbersome and expensive to measure smaller motor real operation and performance.
- With digitalization it is possible to not only to do condition monitoring but also power usage and operation.
- With digitalization it is now possible to “uncover the hidden energy consumers” in combination with Condition Monitoring
- Digitalization enable energy efficiency and sustainability by improved life cycle management

The default assumption is, that the motor dimensioning is correctly done. However, trend data will show how motor is really operated and possible improvements of motor dimensioning can be determined.
ABB Energy Efficiency enabled by Digitalization

1. You and an ABB-certified engineer plan a visit to your facility to get an understanding of the environment. Sensors to be mounted on selected assets. Collect general data during the visit and start collecting data.

2. Data is collected during first 3 months period to verify current performance and operation based on long term usage data.

3. ABB analyses your data utilizing our algorithms based on the data over measurement period.

4. ABB expert will prepare an action plan and give recommendations about where the highest energy savings and best returns on investment can be achieved.

5. Modernize your fleet and continue to monitor performance and savings throughout equipment lifetime.
Energy Efficiency Insights
Combining digital solutions and ABB’s domain expertise

Plug & Play
Motor Agnostic
Domain Expertise
Energy Efficiency Insights
Based on real usage data

High level fleet overview
Fleet KPIs (i.e., heat map of the fleet, loading, efficiency, reactive Power, average consolidated Power usage on the fleet, average consolidated Energy consumption and fleet losses, Preliminary estimate of saving potential (kWh, CO2) etc.)

Detailed asset overview
Asset Parameters and KPIs (i.e., Power Factor vs Load graph, Efficiency vs Load graph, graphical overview of % utilization and load profile, active power (kW), active Energy (kWh), Motor losses (kWh))
Analysis and recommendations by ABB experts (i.e., savings potential (kWh, CO2, $), payback time, Upgrade proposal etc.)

It provides a self-service overview of motors efficiency

ABB expert will support you to achieve higher efficiency through our latest ABB technologies
Motor Smart Sensor

Key Parameters

- Wireless communication
  - Bluetooth® 5.0, Bluetooth® Low Energy
- Certified for Hazardous areas
- Long battery life (up to 15 years)
- Ingress protection: IP66/67
- Superior sensors for dramatically better measurements
- Advanced algorithms to analyze equipment data
Example of a detailed Energy Efficiency Assessment Report

Executive Summary

The improvement potential is summarized below. The histogram between the current fleet and the possible adoption shows the potential improvement potential and impact on CO2 emissions.

Energy consumption analysis

Input power

Reactive, Apparent power and P

Recommendation

Based on the data above, we recommend further analysis which is available through subscription from export reports. The export report is a self-made document in which an ABB expert will suggest the most appropriate and known for repair.

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December 9, 2021 | Slide 26