Drive monitor

Embedded product intelligence that enhances lifecycle management and process performance in drive systems

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Good products offer more to customers when they are combined with comprehensive support and maintenance programs. Optimal performance and minimal maintenance costs (which drive increased operational profitability) can be achieved through service agreements over the lifetime of a product, but effective lifecycle management requires continuous tracking of asset history – operation, wear, damage, and maintenance. Careful monitoring of the condition and performance of assets allows the implementation of predictive maintenance programs that significantly reduce maintenance costs and the risk of asset failure. Without this information, performance suffers and maintenance costs rise.

ABB Medium Voltage (MV) drives in cooperation with ABB Corporate Research has developed a new customer support system – The DriveMonitor – software and hardware that allows an operator to monitor the performance of an MV drive system, collect data and store the drive's history, all from a remote computer. Drive performance monitoring provides also deep insight into the process status – useful extension in analyzing the Operational profitability.

Operational profitability

Real plant systems comprise a wide variety of assets. Some are straightforward, simplistic even, while others are "intelligent," capable of self-diagnosis or even self-correction. All of these assets need careful monitoring. Large and critical assets often come with their own supervisory control systems, but all of the assets in a process chain are information providers – either directly, via in-built sensors, or indirectly, by reporting on other assets in the chain.

Cost-effective data collection and processing

An efficient lifecycle management system requires scalable tools that can be adapted to the nature of an asset, its value, status, and general maintenance policy. The first aspect to be considered is the comprehensiveness of the system: whether it be a single asset (eg, a drive), or a whole production line, which contains many assets. The second aspect is the availability of data: from "what's already there" to dedicated measuring systems that detect vibrations, current, corrosion etc. The third aspect relates to increasing levels of knowledge content and diagnostic functions: at one extreme having a simple limit threshold, at the other, having advanced lifetime prediction algorithms.

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To target low tool costs one has to concentrate on scalability and configuration flexibility. Similar assets should be treated similarly, but with individual attention dependent on their context in the system. For example, two electric motors might be identical, but if one is running a ventilation fan of low importance and the other a critical fume-exhaust fan, their maintenance programs would be similar, but the level of investment in each would differ according to their importance.

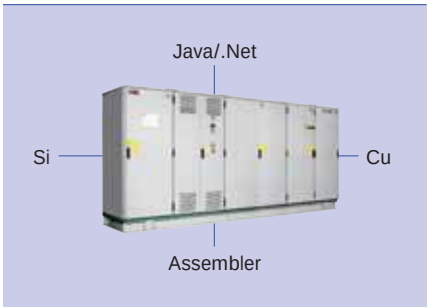
A scalable system is not the same thing as a combination of different approaches that address different aspects of lifecycle management. To be efficient, a tool must guarantee full data interoperability, single data entry points, and unified interfacing, usage and reporting. Multiple systems can be combined in an IT integration project, but only a scalable tool can provide true maintenance optimization.

In short, individual assets must be assessed to determine the level of investment that can be justified by their individual roles in a process.

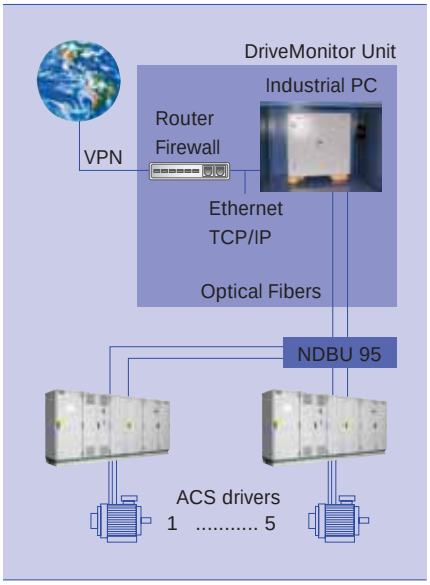
A good condition assessment system is:

- expandable, to accommodate single or multiple asset objects
- able to apply rules of various complexity to the assets – vibration-based, temperature-based, electrical test-based, operation data-based, statistics- and history-based etc.
- able to acquire data from various sources, eg, drive systems, control systems, vibration measuring tools, manual entries, and the asset itself.
- ABB has used this methodology in the development of its Asset Opti-

1 MV drive – an asset with a broad technology span and a rich information source



2 The DriveMonitor™ design principles



3 DriveMonitor – Analyzing the system's heartbeat. Drive information can be utilized on various diagnostic levels – from the converter unit to the process section

mization/Asset Monitors concepts and DriveMonitor is a part of this truly scalable solution 1.

ABB Drives – assets as "knowledge containers".

ABB MV Drives focuses attention on product design and development, but also on configuration and optimization in relation to customer applications. A quick look "under the hood" of a drive unit will immediately show that the technological complexity of this "torque delivery plant" ranges from copper bars to electronic circuit boards. Its software ranges from assembler code to the newest high-level languages. To obtain the highest possible performance from such a device over its entire lifetime requires some attention. However, drive units, such as the MV Drive from ABB, are huge banks of data, recording information relating not only to the drive converter performance, but also to the driven equipment, and even to the whole downstream production process. Efficient use of these drive data is the first step towards the lifecycle management – at first for the converter itself, ultimately for the whole drive-powered process.

Efficient lifecycle management

A pragmatic approach to lifecycle management issues should answer the following questions:

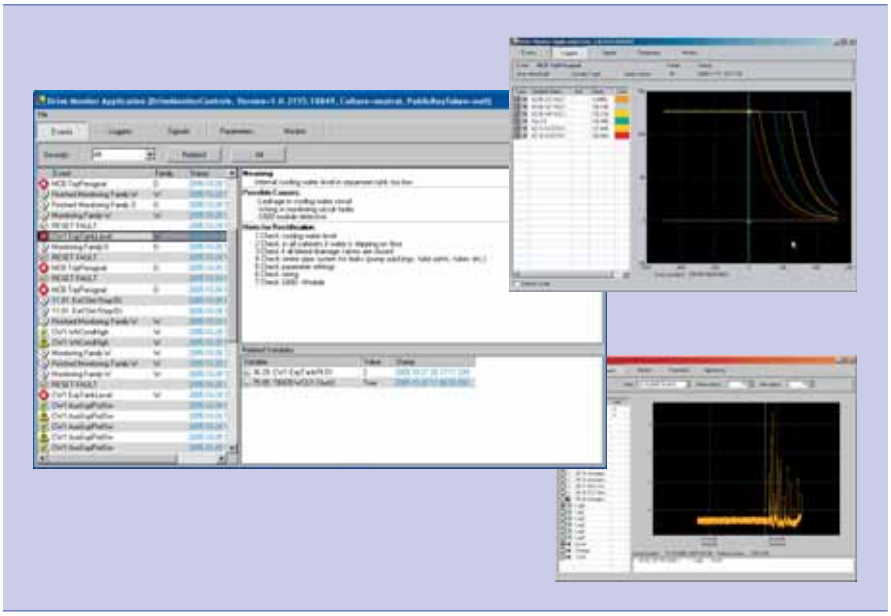
- What should be done to the asset in order to maintain the highest performance and the lowest costs.
- When should this action be taken?

Ideally the asset should be intelligent enough to provide this information to the operator. Alternatively, the intelligence can be embedded as the asset extension – intelligence that utilizes fully the amount of data processed in the drive.

In order to keep tool costs down, maintenance systems should be flexible and able to accommodate a wide range of asset types.

The DriveMonitor system is designed to meet these requirements. On the one hand it provides continuous monitoring and analysis of the drive state and operation, supports root-cause analysis (RCA) and helps to follow predictive maintenance paths. On the other, it provides a platform upon which to offer the customer unique extension features that, by utilizing drive signals, allow the operator to visualize the whole shaft state along with process-related KPI's, etc.

Extended support information facilitating root-cause analysis



DriveMonitor: embedded intelligence, scaleable and secure

The DriveMonitor system consists of a hardware- and a software layer 2. The hardware layer is a properly interfaced industrial PC that is factory installed in the most powerful new ABB MV Drives (it can also be offered as an upgrade to existing models). The software layer automatically collects and analyses selected drive signals and parameters. The DriveMonitor hardware is based on an industrial PC platform to provide the expected longevity and remote accessibility. Virtual Private Network (VPN) solutions are used for remote access to ensure high security.

Scalability – the biggest challenge

The DriveMonitor software layer is extremely flexible with respect to the configuration of diagnostic rules, the range of the assets with which it can be used, its alarm and reporting functions, and its data intake sources. Being compatible with ABB's Asset Monitor family, DriveMonitor opens the door to the whole ABB Asset Management portfolio, with Asset Optimizer and other Asset Monitors as optional extensions. DriveMonitor can be easily integrated into automation systems using the ABB 800xA platform (other systems can be connected through OPC[1)] servers). The DriveMonitor is designed to be used with a single drive, and with large systems. There are possibilities for expansion to include other measurements such as corrosion, vibrations, additional temperature sensors, etc. It provides millisecond-based sampling rates with year-based scheduling, event-driven actions and alarms, and more. The various DriveMonitor components can be distributed to different computers. For instance, several DriveMonitor units can be configured in parallel to cover larger installations and the results can be brought to a central control room PC for operator convenience.

Application area

The basic function of the DriveMonitor is to "watch" the converter part of

Footnote

[1)] OPC-OLE for Process Control

a drive shaft system 3. It continuously monitors the drive status and responds when that status changes. Changes in drive status can be caused by drive faults (unexpected drive stoppages), alarms (signals crossing threshold values), user-defined parameter changes, and higher level, DriveMonitor-generated application-specific alarms.

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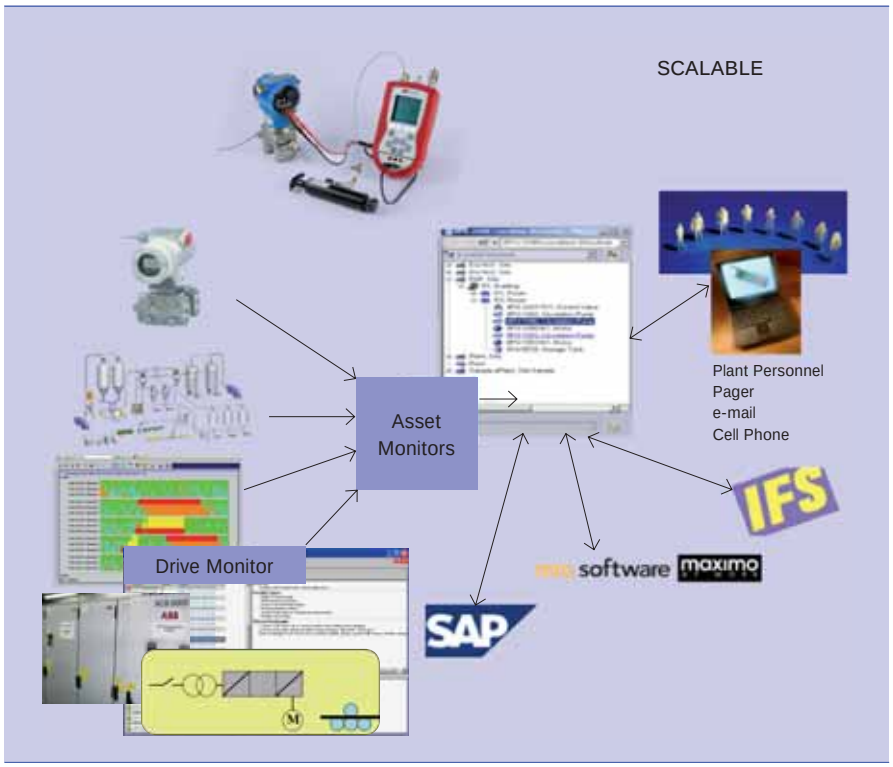
With extra diagnostic packages, DriveMonitor can follow other shaft train components such as the main circuit breaker, the transformer, and the driven machine. At the highest level, specialist packages directly related to specific application areas (such as rolling mills, water pumps, and compressors) can be integrated into the system. This kind of expansion can be done at any point in time depending on the customer's needs. It is also possible to incorporate extra measurements that go beyond the drive signals. DriveMonitor-based diagnostic routines are valuable extensions to plant-level Asset Management program such as ABB Asset Optimization solution. The DriveMonitor block is an easy fit to already installed ABB control platforms and on the other hand can be a good start for plant Asset Management solution.

Oil and gas – Ras Laffan pumping station

The pumping station consists of 27 pump units using, in total, more than 19 MW of power delivered by ABB electrical motors and ACS6000 drives. All drives are supervised by the monitoring package, but as an extension, the data from the ABB AC800M controllers that control the pump line operation are processed by the diagnostic package. Without requiring additional investment in hardware or measuring devices, the system watches the status of the motors and the pumps' temperatures, operating conditions and vibration levels processed for the controlling purpose by AC800M units. In this way, a high added value is obtained at low investment cost. All results are integrated into the 800xA Workplace panel giving the operator visually compatible status information – not need to learn yet another platform for condition monitoring as it is typically the situation in industrial plants.

DriveMonitor – shaft-line overview



DriveMonitor™ continuously monitors the drive status and responds when that status changes.

Rolling mills – Seeing the process "heartbeat"

ABB Drives are very powerful and configurable units in a process. Their status is not only converter-related, but reflects several parameters that reflect the process status. These parameters include shaft torque, phase current and phase voltages. These data – as provided by the drive unit and analyzed by the DriveMonitor – can return valuable process status information regarding process outliers, process drift and changes. Again, at no hardware investment, drive data is mapped against traditional process information from the control platform – and all this is enabled by systematic and coordinated development of the ABB Asset Management platform – both from the product and the system sides.

Concluding remarks

ABB process automation offers complete systems for the plant asset management that are in all respects compatible with ABB's product portfolio – generating high level benefits at low investment costs. 1+1 can equal 3 or even 5 in this case.

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