A Complete Turnaround

Jonas Berge explains how new technology and work practices are heralding a new era in intelligent device management.

Automatic delivery of self-diagnostic information from intelligent on/off valves, electric valve actuators, gas chromatographs, tank gauging systems, valve positioners, and other instrumentation gives operators the ability to tend to the process before it is upset, and allows the maintenance department to plan daily work and minimize scope for shorter turnarounds.

Now, new technology and work practices are heralding a new era in intelligent device management.

Plants can make intelligent device management software part of asset management systems a natural part of everyday operations for years to come by following a simple process from audit, device alarm rationalization, work practice review, and training.

Thanks to the NAMUR NE107 recommendation, more devices and systems now support this alarm rationalization. The work processes have been established and standardization work has been started by an ISA committee – ISA108. This committee will define standard templates of best practices and work processes for design, development, installation and use of diagnostic and other information provided by intelligent field devices in the process industries.

And as further detailed by ISA, the scope of the committee work products will include recommended work processes and implementation practices for systems that utilize information from intelligent field devices and the people who use them. Work process templates by worker roles (such as maintenance or operations) will be one area of research. Best practices for implementation will be developed. Models will be developed for the flow of information from devices through the various systems that use the information.

Device diagnostics yesterday

All plants have intelligent 4-20 mA/Hart, Foundation fieldbus, Profibus, or WirelessHart devices, but not all plants have been able to reduce maintenance costs using device diagnostics. Some of the reasons maintenance software initially did not become part of daily maintenance practices and turnaround planning include:

- In the past, computers, software, and the internet were not yet part of everyday life and therefore people were not comfortable learning maintenance software.
- Early systems used slow multiplexer architecture resulting in device diagnostic alarms not arriving in a timely manner.
- Most systems had no digital integration with devices and relied instead on handheld field communicators.
- The maintenance software was only available on a separate computer, often located in remote buildings
- Device diagnostic alarms were not classified and therefore could not be routed to the relevant person.
- Operators were flooded with nuisance alarms and so disabled all device diagnostics.
- Devices were not ranked for criticality and, subsequently, maintenance personnel could not prioritize their work.
- Only a portion of devices were capable of predictive maintenance.
- On/off valves, gas chromatographs, electric actuators, and tank gauging systems were not networked to the system.
- Daily maintenance and turnaround work processes were not changed to use device diagnostics in planning and troubleshooting.
- Device diagnostics alarm messages were not clear and easily understandable, did not provide guidance towards the correct action, and did not focus attention on the important aspects.
- Device diagnostics was not configured properly, resulting in undetected problems and false alarms.
- The maintenance software was not kept up to date with new types and versions of devices, and gradually fewer devices remained integrated.
- No training was provided on how to use the maintenance software.

As a result of all these factors, most plants did not realize the value of device diagnostics to operation, daily maintenance, and turnaround planning in the past. However, over the past 15 years, computers and the internet have made their way into every home, often wirelessly. Downloading files from the internet and synchronizing files with digital cameras and smartphones

is part of daily life. Today most people are computer savvy, which was not the case only a few years ago.

This is one of the greatest factors now paving the way for the cultural shift of using digital devices and intelligent device management software for daily maintenance planning and troubleshooting. There is no need to be a programmer to use these tools; basic computer skills are sufficient.

Systems requirements

Permanent communication infrastructure and Intelligent Device Management (IDM) software has to be put in place to continuously monitor the health of intelligent devices. Modern systems have support for 4-20 mA/Hart, Foundation fieldbus, Profibus, and WirelessHart integrated in the control system itself without the need for external third-party gateways or slow multiplexers. Faster networking and report by exception ensures delivery of device diagnostic alarms in real-time, enabling the operator to take action.

	Description	Responsibility
Relevant	Sent to the right person: technician, as well as operator if it has an impact on the process	System engineering
Unique	Not merely a repetition of information from another diagnostic alarm	Device must not generate more than one alarm for the same fault
Timely	Arrives at the right time, comes up neither long before intervention is necessary nor too late for action to be taken	The system architecture must provide fast capturing of device diagnostic alarms in real-time, since some faults will impact the process within minutes. Device must not generate predictive diagnostics alarms too early
Prioritized	Criticality of the device to the process, indicates the urgency of the problem requiring action	System engineering
Understandable	Contains a clear message that is easily understood, not a cryptic code	Device description file
Diagnostic	Helps with the identification of the problem	
Advisory	Provides guidance towards the correct action	
Focusing	Directs attention to the important aspects	

Table 1: Characteristics of a 'good' device diagnostic alarm.

Intelligent device management software workstations have to be located where relevant personnel can use them. This usually means multiple clients are required. For the purpose of daily maintenance and turnaround planning, a client is required in the maintenance planning office. For the purpose of troubleshooting and calibration, a client is required in the workshop.

Intelligent device management software clients are also required to be integrated in the DCS operator consoles in the control room where operators use critical device failure alarms as an early warning to tend their process before production is affected. A single workstation in a separate local equipment room (LER) / field auxiliary room (FAR) building will not do.

In a new plant, devices should be integrated with the intelligent device management software so they can become part of the predictive maintenance scheme. Intelligent on/off valves with digital communications and built-in diagnostics should be used in place of "dumb" solenoids and limit switches. Intelligent on/off valves can use bus or wireless. Electric actuators and tank gauging systems should use standard communication rather than proprietary protocols. Variable speed drives and motor starters in the MCC all have diagnostics and many configuration options that can be integrated with the intelligent device management software through Profibus-DP.

Raising the alarm

The EEMUA 191 process alarm management and rationalization specification defines eight criteria for a "good" process alarm. And this criteria can be adapted to define the characteristics of a device diagnostic alarm. The characteristics are captured in Table 1.

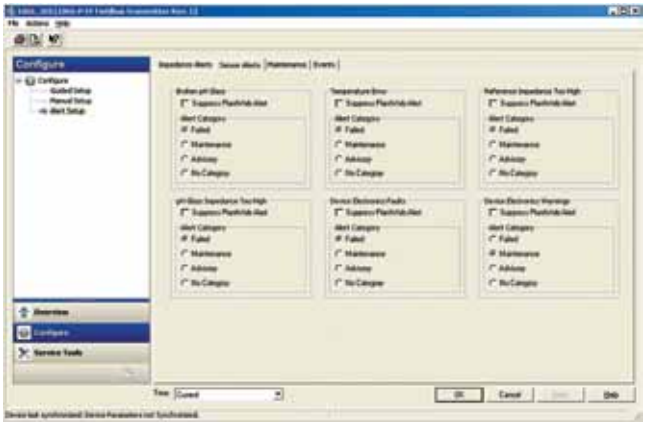
Operators need to know about device problems, but only if they impact the process. Typically, a device failure will impact the process within minutes or hours. A device diagnostic alarm would be an early warning for the operator to tend the loop, before the process is upset. These alarms must come to the operators very quickly to give them time to react. However, operators must not be flooded with all device diagnostics alarms which would distract them from the process. Only severe failures should be routed to both operators and maintenance for immediate action.

Device diagnostic alarms of an advisory nature are not urgent and only relevant to maintenance, for planning of daily work and turnarounds. A formal process to rationalize the device diagnostic alarms should therefore be undertaken, similar to what is done for process alarms. This is a new engineering task.

Intelligent device management software suppliers offer services to assist in implementation of device diagnostic alarm rationalization. Operators are not responsible for repairing failed devices, and therefore do not need device troubleshooting details. Operators only need to know what happened to the device so they can look after the process. Maintenance technicians on the other hand require detail tips for a solution and to assist in maintenance and turnaround planning.

Thanks to graphical device user interface based on the IEC 61804-3 EDDL (www.eddl.org) standard, cryptic error messages like "Error 13" are a thing of the past. In less than three clicks from the device diagnostic alarm, the problem is presented with an intuitive name as well as a clear description of the problem and illustration of where the problem lies.

Intuitive guidance for troubleshooting is provided, with information on points to check, likely causes and potential issues which can be checked from the software. Older devices can also benefit by loading a newer enhanced version of the device



Categorizing device diagnostics alerts.

NE107 defines standard icons and colors to signal the device status, which makes assessment of device health easier.

description file. Plants should upgrade their system to the latest software version to enable them to take advantage of these graphical device user interfaces.

Simplifying status

Device diagnostics can be configured to one of the status categories in the NAMUR NE107 recommendation: Failed, Off Specification, Maintenance Required or the slightly different Function Check. This simplified status signal makes device health easy to overview and is the basis for routing device diagnostic alarms to the right person regardless of communication protocol used by the device. For new projects, make sure to use a system and devices that support device alarm routing based on NE107 or equivalent. Existing system software can be upgraded to NE107 support.

NE107 also defines standard icons and colors to signal the device status in the dashboard part of the device description file. Such a dashboard can be displayed both in the intelligent device management software as well as on the operator console.

The criticality of a particular loop and its devices device is application specific. The device alarm rationalization process ranks criticality based on process impact severity and allows maintenance to better prioritize their work. This requires engineering at system implementation.

Category	Icon	Severity	Description
Failed		High	Process variable invalid due to malfunction in the field device
Off Specification		Medium	Not a failure. The device is operational, but it is a warning it may be degraded and it needs attention.
Maintenance Required		Low (Advisory)	The device is operational, and not yet degraded, but the wear reserve is nearly exhausted or a function will soon be restricted due to operational conditions e.g. build-up of deposits.
Good			The device operates normally
Check Function			Output signal temporarily invalid (e.g. frozen) due to on-going work on the device.
Disabled			Device diagnostics has been disabled

Table 2: NAMUR NE107 device diagnostics status categories.

Changing work processes

Daily maintenance and turnaround work processes for planning and inspection created around a handheld field communicator do not take full advantage of intelligence in field devices, and must be rewritten around the intelligent device management software part of the asset management system. This requires a shift in maintenance culture. Intelligent device management software suppliers offer services to assist in incorporation of device diagnostics in work processes.

The work process must be rewritten such that the operators themselves check if a device is not working based on the simple NE107 status signals and need not enter a work order to maintenance. The work process for maintenance shall be rewritten such that the technician checks the software first, before applying work permit and going to the field.

This way the technician can tell if maintenance is required at all, and if so, if the device can be repaired in the field or needs to be pulled, and which parts and tools to bring along. This reduces unnecessary field visits where no action is taken and speeds up repair time.

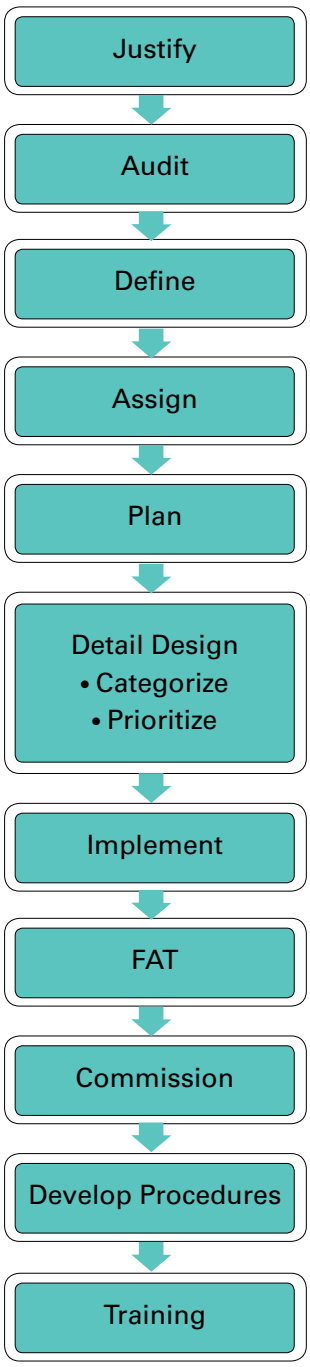
The daily maintenance routine must start with checking the intelligent device management software alarm summary first for a prioritized listing of devices in need of maintenance, to know which devices are in most urgent need of service that day, and to schedule the day's work accordingly.

For instance, device self-diagnostics such as built-in continuous valve friction monitoring in a valve positioner reports to the intelligent device management software when friction is high and the valve maintenance should be planned. With the hardware, software, and standard operating procedures in place, central "desktop maintenance" planning can become a reality.

For a plant turnaround, the planning procedure should be to

check the software first, well before the turnaround, to determine which valves and which flowmeters really need to be pulled out for maintenance or sent for calibration, and which ones do not. Thanks to valve signature diagnostics in valve positioners and meter verification in flow transmitters, it is possible to tell which valves have suffered wear-and-tear and which flowmeters have drifted. These tests are non-intrusive and can be done while the plant is still running.

Using this methodology, the scope of the turnaround maintenance can be reduced, freeing up resources for other turnaround tasks and also shortening the duration of the outage. The serious cases are prioritized and done first, while the rest are done if there is time left over. Savings from not wasting time and resources on valves and flowmeters not in need of service include costs for cranes, hoists, scaffolding, fitters, riggers, instrument technicians, plus insulation and other material.



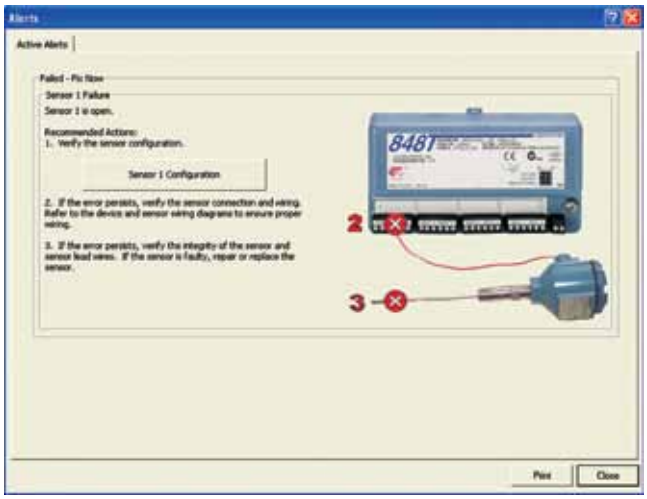
The steps involved in deploying intelligent device management software.

Diagnostics lifecycle

Some diagnostics, particularly process connection diagnostics such as plugged impulse line detection, process noise, empty pipe, and valve wear and tear, etc need to be configured or be commissioned in a learning mode to first establish the baseline for normal process condition such that an abnormal process condition can be detected based on deviation.

This is an important step to ensure diagnostics do not report a failure when really there isn't (false positive), and to ensure that diagnostics does not miss a failure it was meant to detect (false negative). The best time to do this is some time after the busy startup period when the process has stabilized and normal has been established.

Keeping the system up to date with the latest types and versions of devices as they come into the plant as part of replacement and expansion activities is important to ensure the intelligent device management software continues to be used for predictive maintenance for years to come. If not, the system will gradually fall into disuse and the plant returns to costly reactive maintenance on a daily basis and unnecessary preventive maintenance for turnarounds.



Troubleshooting tips for multi-input temperature transmitter.

Getting the Device Description files for a device has been made much easier thanks to the internet, which allows device files to be downloaded onto the system. However, a recent development is an automatic subscription service which periodically checks what new device description files have been made available, and automatically loads them on the system. This way the system is always ready to accept new types and versions of devices as they are deployed in the plant, providing full access to device configuration and diagnostics. This capability is available in some new systems, but existing systems can be upgraded to support such a service.

For a new control system the operators get training on the operator software. Similarly, maintenance personnel need training on the intelligent device management software in order to get the most out of the system and to take full advantage of the capability of intelligent devices. The training should include understanding the NE107 status signals, how to navigate device menus, configure and tune device diagnostics, printing daily reports, and search for tags, etc.

Perceptive technology

By combining the elements of NE107 device diagnostics alarm rationalization, predictive device diagnostics, intuitive device dashboards, and automatic device descriptor update services, intelligent device management can become and remain a natural part of daily maintenance and turnaround planning.

As a result, operators can act on device problems before the process is affected, thus avoiding downtime and lost production. Unnecessary visits to the field can be avoided by distinguishing device problems from process problems, reducing maintenance cost.

Needlessly removing flowmeters for calibration, or tearing down valves for inspection during turnaround can be avoided, shortening the outage and reducing logistics. More information on the work processes is in *Device Diagnostics Deployment and Adoption Guide*, which is available from the EDDL website (www.eddl.org).

CEA

Jonas Berge is Director, Applied Technology, Emerson Process Management.