Using Device Diagnostics in Maintenance Practices

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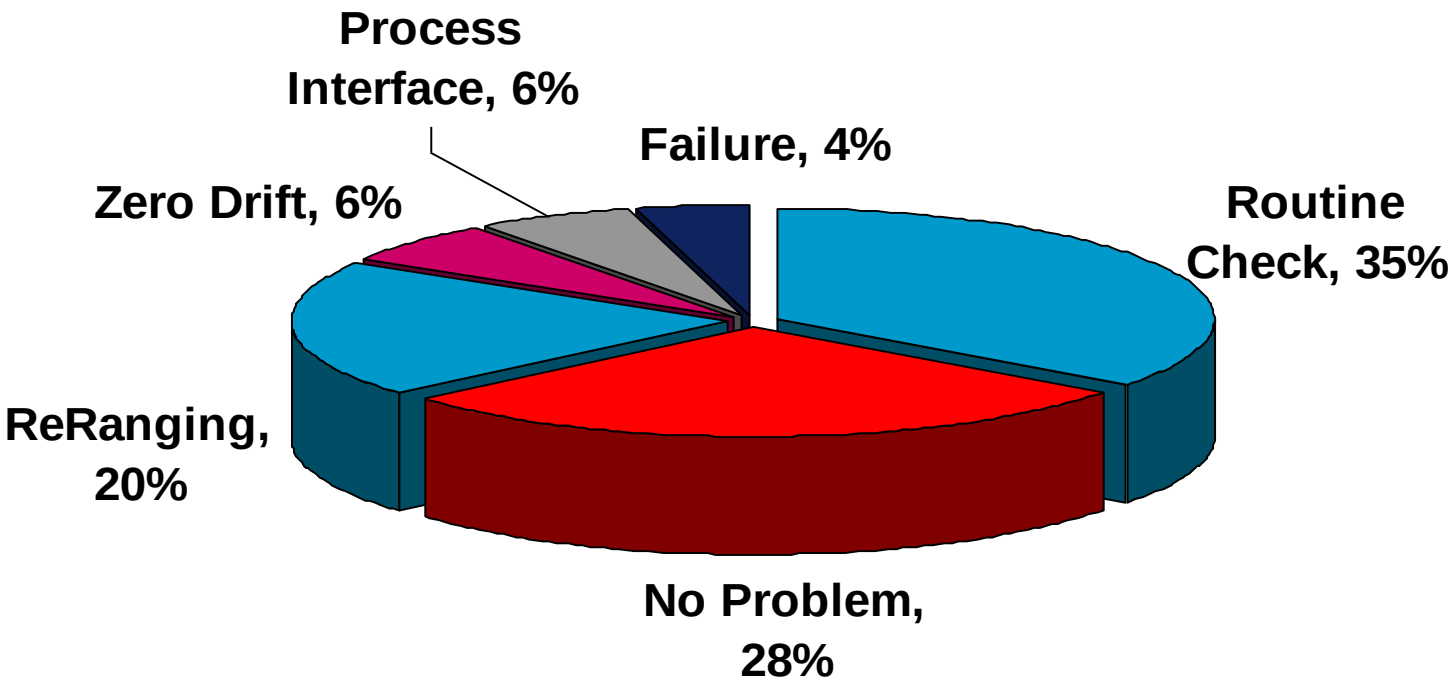
On behalf of
Fieldbus Foundation ™

Device Maintenance Effort



63% of time is spent investigating “problems” that do not exist.

Courtesy of Hydrocarbon Engineering April 2004

Maintenance Data Impacts Operations

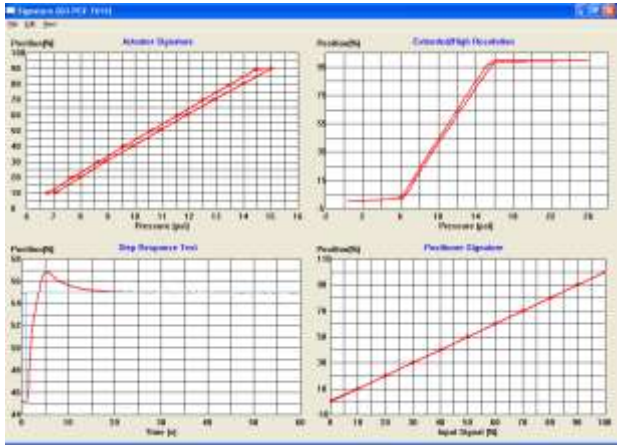
Goal = Improved operational efficiency

- Predictive/Pro-Active maintenance
  - schedule maintenance based on real-time device and process diagnostics
  - **increase plant availability**

Valve Diagnostics

Diagnostics functions

- Control valve diagnostics functions
  - Total travel time
  - Number of cycles
  - Time open/close/near close
- Positioner diagnostics functions
  - Position/ temperature/ pressure range over detecting
  - Valve controllability monitoring
  - Component failure



- Perform calibration automatically/remotely
- Characterize valve position for optimal valve control

Transmitter Diagnostics

- Electronics Hardware failure
- Measuring sensor aged/degradation
- Damaged or damp connection
- Reference sensor broken
- Sensor not immersed in process
- Reference sensor fouled
- Insufficient electrolyte
- Temperature sensor open or shorted
- Conductivity too high

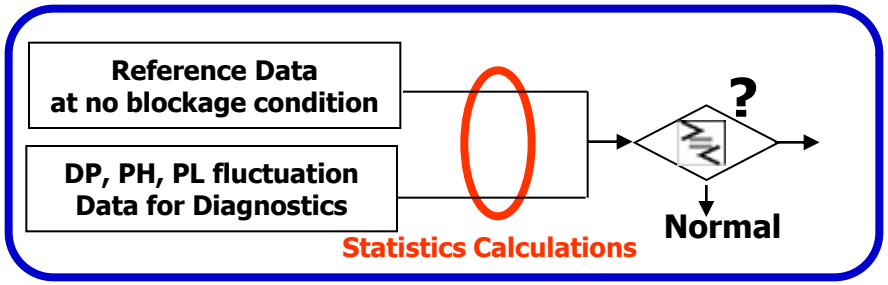
Clogging of flow
Signal fluctuation
Vibration

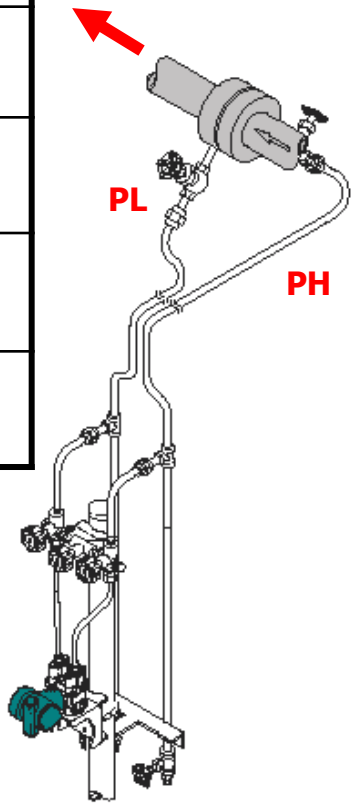
Electrode Adhesion level
Empty Pipe

Process Interface Diagnostics

– **Device enables detection of plugged impulse line**

	Blockage at both H/L side	Blockage at High side	Blockage at Low side	No Blockage
DP (Differential Pressure)				
PH (Static Pressure H side)				
PL (Static Pressure L side)				
Outcome	DP, PH, PL Low fluctuation	PH Low fluctuation	PL Low fluctuation	Independent fluctuation



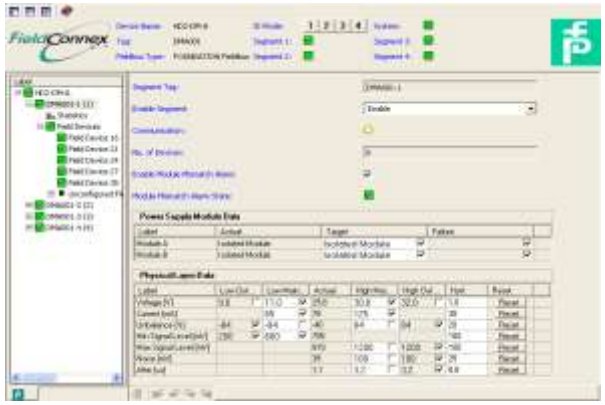


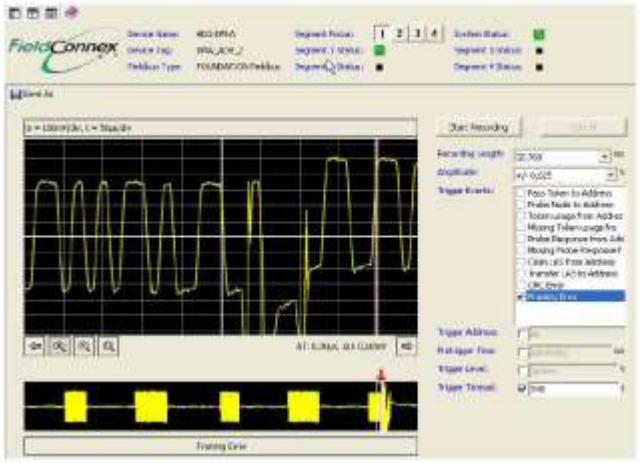
Justifying Intelligent Device Management

- Ability to tell a device needs calibration
  - Only Calibrate when it is necessary
- Ability to tell a device does NOT need service
  - No Necessity to waste any resources
- Ability tell what service does the device require
  - Can fix it quicker, and bring the right tools and spares
- Ability to predict device failure before it actually fails
  - Can avoid and prevent the failure
- Ability to tell a device has failed and process control will be affected
  - Can avoid a simple device failure that can lead into a process shutdown

Why has Online Device Diagnostics not Been Fully Utilized?

- Device diagnostics works
- However, this diagnostics has often not been made a natural part of daily work processes
- A shortcoming in many plants regardless of protocol used:
  - 4-20 mA/HART
  - PROFIBUS
  - FOUNDATION fieldbus





A ‘Good’ Process Alarm

- The EEMUA 191 process alarm management specification defines eight criteria for a ***"Good Alarm“*** – the same applies for device diagnostics

Relevant	Justified and not insignificant in the operator's priorities
Unique	Not merely a repetition of information from another alarm
Timely	Comes up neither long before intervention is necessary nor too late for action to be taken
Prioritized	Indicates the urgency of the problem requiring operator action
Understandable	Contains a clear message that is easily understood
Diagnostic	Helps with the identification of the problem
Advisory	Helps to find the correct action -
Focusing	Directs attention to the important aspects

A ‘Good’ Device Diagnostic Alarm

- A ***‘Good’*** device diagnostic alarm should be:

Relevant	Sent to the right person: technician, as well as operator if it has an impact on the process*
Unique	No duplications
Timely	Sent at the right time: not too early, not too late
Prioritized	Criticality of the device, severity of the problem
Understandable	Provide a clear message that is easily understood, not a cryptic code
Diagnostic	Helps with the identification of the problem
Advisory	Provides guidance towards the correct action
Focusing	Directs attention to the important aspects

*Only a small percentage of device alarms (outright failure) have an impact on the process

What Has Been Missing?

- Time-tested work processes were not re-written to utilize diagnostics
- Device diagnostic in the past was not “Good” enough :

Relevant	Device diagnostics was not sent to the right persons; work stations were located remotely, operator did not see device alarms
Unique	Some duplication, but not a major issue
Timely	Slow multiplexer architecture
Prioritized	All device alerts had the same priority regardless of device criticality or fault severity
Understandable	Cryptic error codes were displayed
Diagnostic	No explanation of problem provided
Advisory	No troubleshooting guidance provided
Focusing	Didn’t highlight the important aspects

Support for Multiple Protocols is Required for Timely Diagnostics from All Devices

Device Type	HART	DPv1	PA	FF-H1
Transmitter / Analyzer / Meter	Y	-	Y	Y
Control valve positioner (pneumatic)	Y	-	Y	Y
Electric actuator / MOV	-	Y	-	Y
On/Off valve (pneumatic)	-	-	-	Y
Proximity switches	-	-	-	-
Solenoids	-	-	-	-
Remote I/O box	-	Y	-	Y
Drives, motor starters, MCC	-	Y	-	-
Safety transmitter (4-20 mA)	Y	-	-	-
Shutdown valve partial stroke tester (discrete on/off signal)	Y	-	-	-
Gas chromatograph	-	-	-	Y
Tank gauging system	-	-	-	Y

- One protocol does not cover all devices
- Solenoids and proximity switches are not smart; use fieldbus on/off valves with built-in

Workstations Have to Be in the Right Place to be Seen by the Relevant People

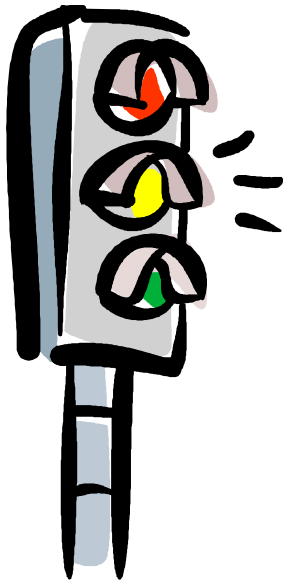
- In some plants the device management workstation is in the Local Equipment Room (LER) in the field
  - Nobody wants to go to the LER
  - Make sure to have access from the CCR
- In some plants the device management workstation is in the control room, but in a separate computer in the corner, requiring another login
  - Too tedious for operator to login, and type the tag to search, so just call the technician
  - Make sure to have access to device diagnostics from the operator station in three clicks or less

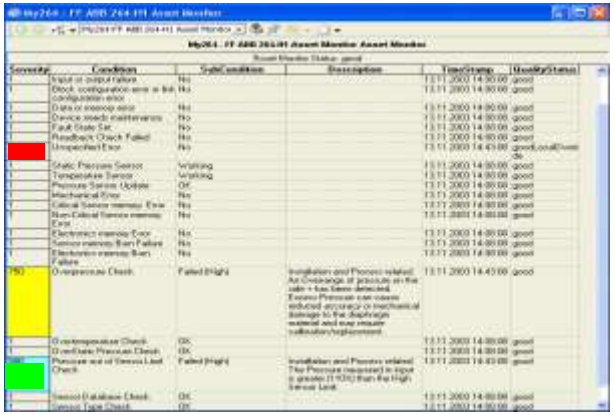
Relevant Information to the right users

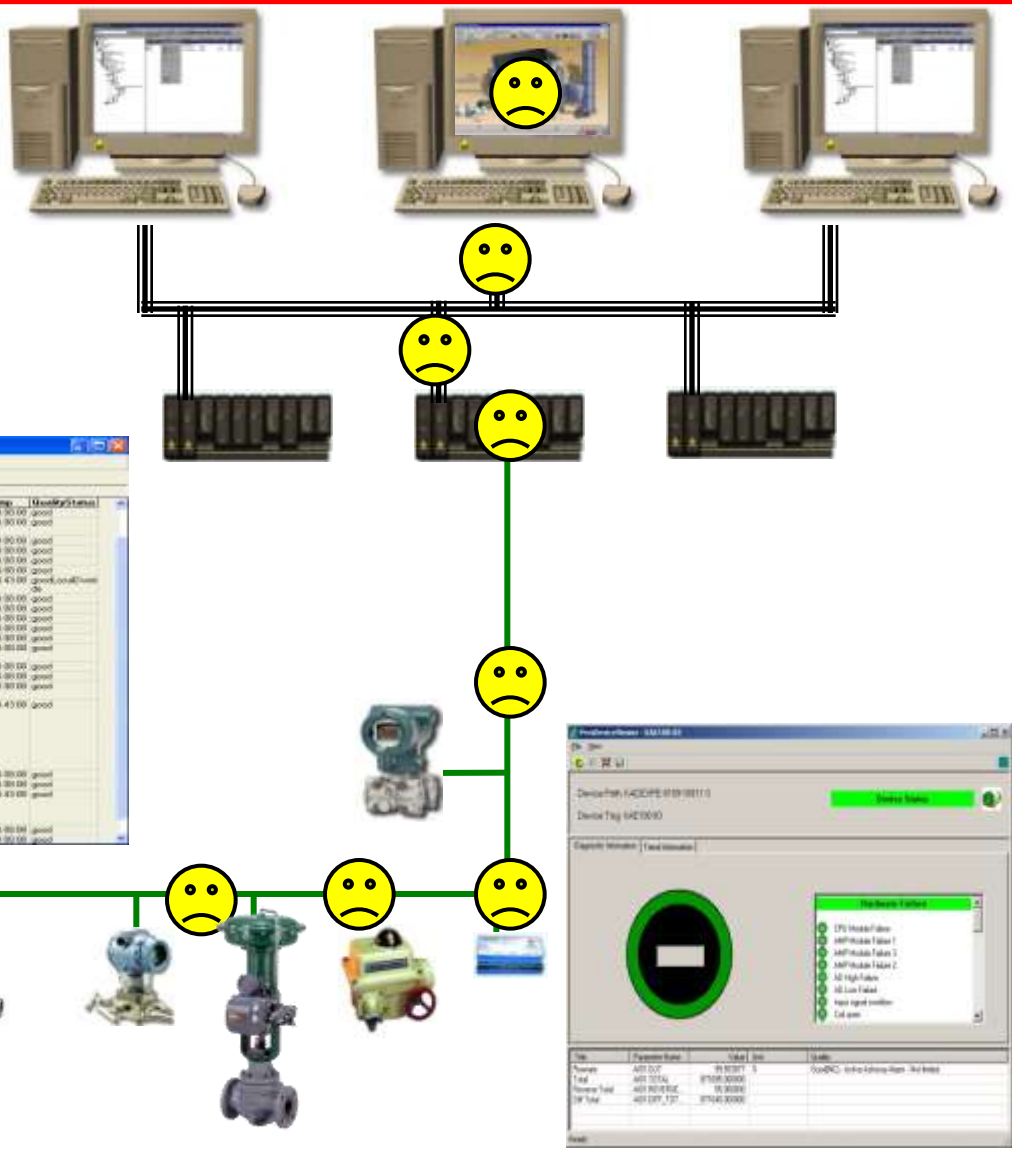
- Reduced time to get right information
- Fast and easy for the operators to create fault reports
- Effective maintenance procedures before the problems affect the process
- Simplifies collaboration between operators and maintenance
- Combine with Asset monitors for predictive maintenance

Device Notification to the right person at the right time

- Event is time-stamped at the source
- Device Alarm is sent to the Host and then HMI

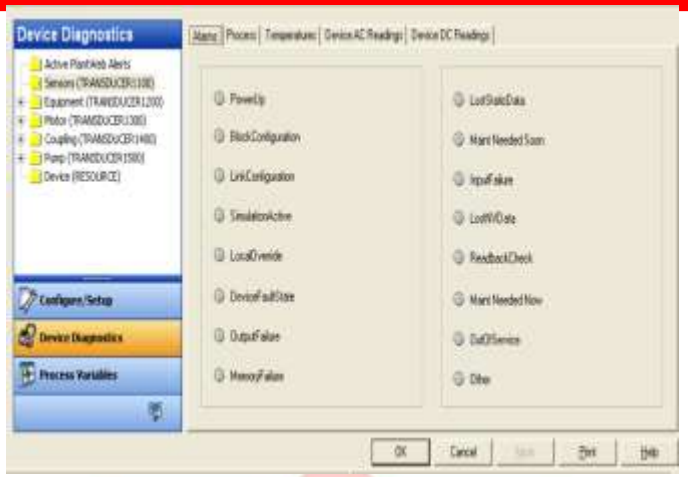


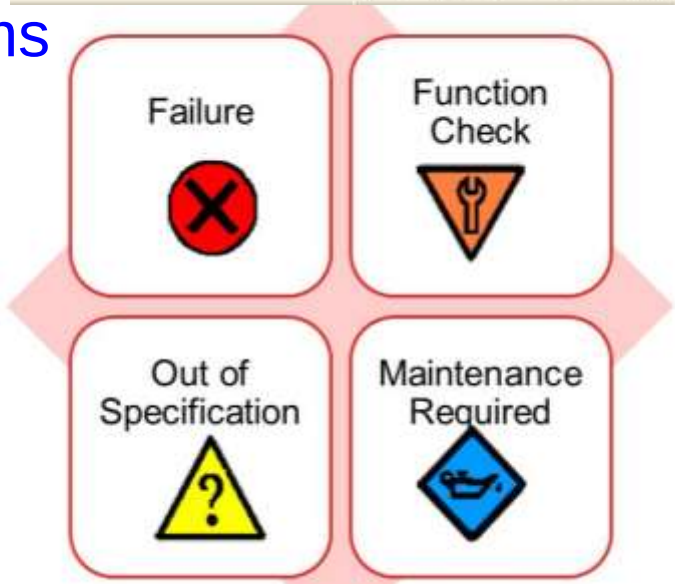




Device Diagnostics Has to Classified to be Routed to the Relevant People

- A device failure will within minutes or hours affect the process
- In the past, operators did not get device diagnostic alarms
  - Make sure to route Failure alarms to operators as early warning
  - Make sure to classify and filter device alarms
    - Such that operators are not flooded with the other alarms
- This requires engineering work, just like process alarm management



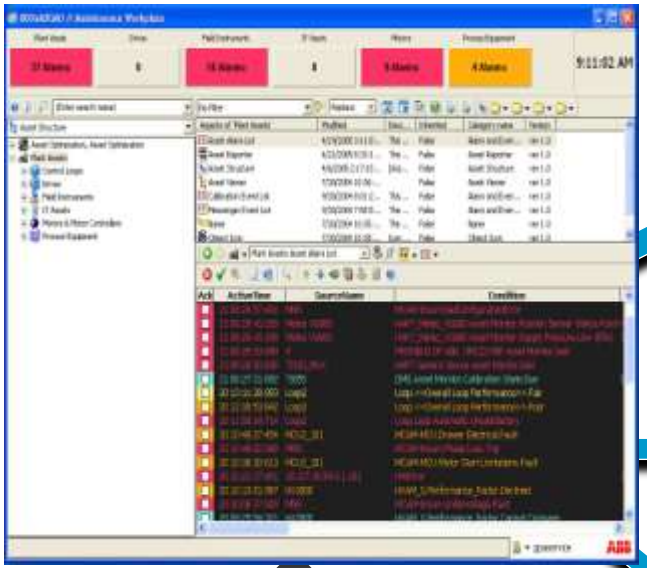


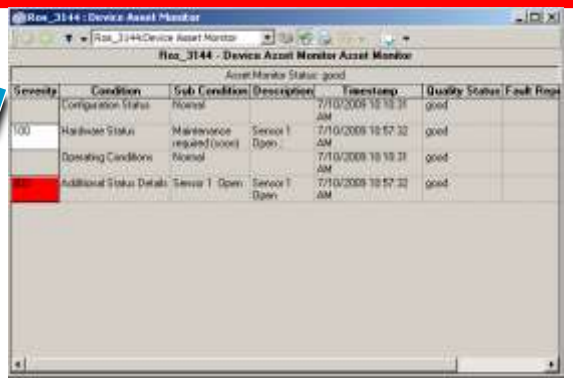
New FF field diagnostics classified per NAMUR NE 107 status signals

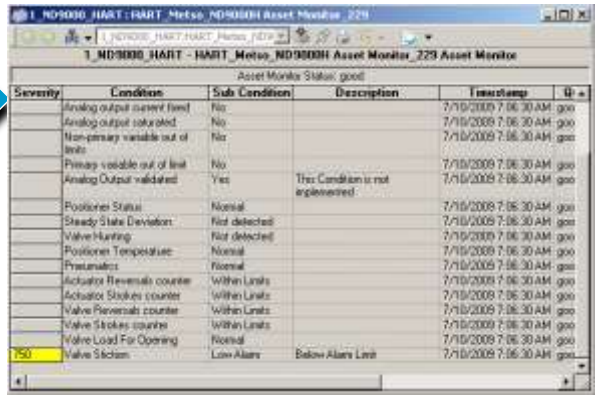
Device Diagnostic Alerts Must be Prioritized To Prioritize Service

- In the past, device diagnostic alarms were not prioritized
- Thus diagnostic alarms could not be filtered
  - The operators got all or nothing – both not acceptable
  - Technicians could not prioritize troubleshooting
- Make sure to prioritize the device diagnostics alarms based on:
  - Device criticality (importance to the process)
  - Problem severity
- This requires engineering work, just like process alarm management

Device Alarm Priority and Classification





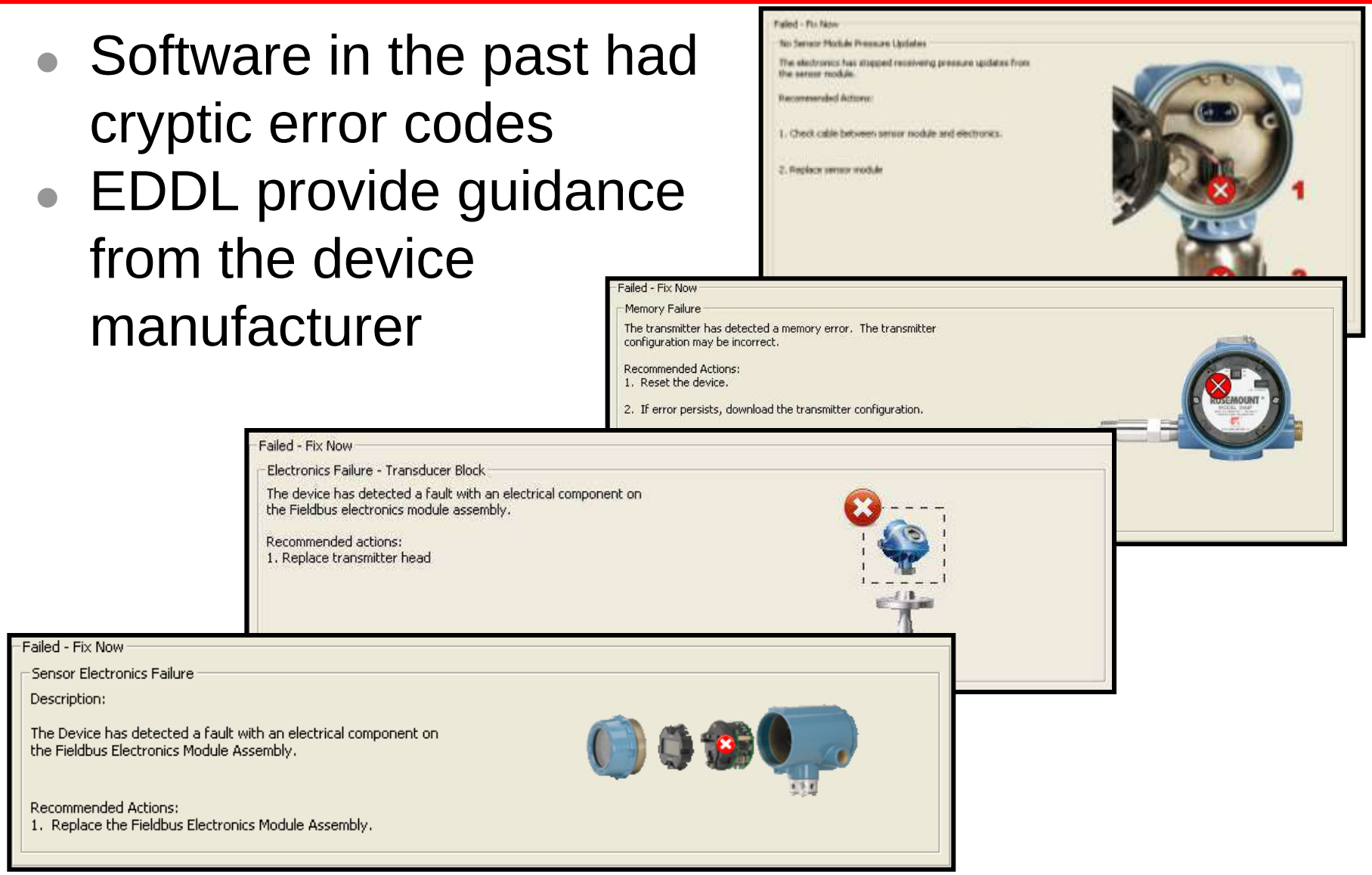


FISHER

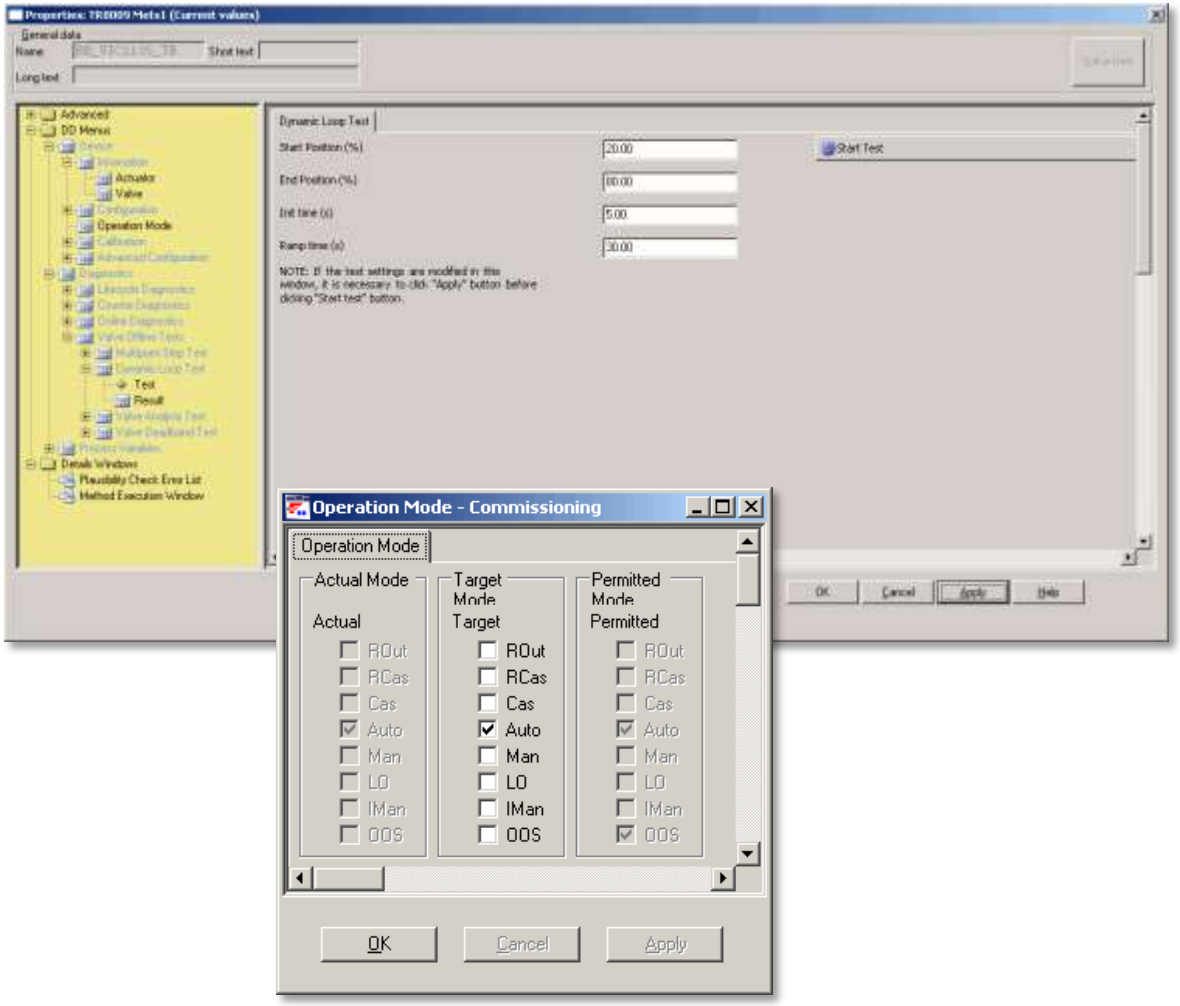
4. Additional Status Details	
0	Normal
1	Position sensor Failure
2	Pressure sensor Failure
3	Temperature sensor Failure
4	Critical NVM Alert
5	Drive Current Roadback Fail
6	A/D Reference Fail
7	No free time
8	Program memory fail
9	Auto Cal in progress
10	Input characterization
11	Custom characterization
12	Reverted to pressure control

The User Interface Must Be Understandable, Advisory, and Focusing

- Software in the past had cryptic error codes
- EDDL provide guidance from the device manufacturer

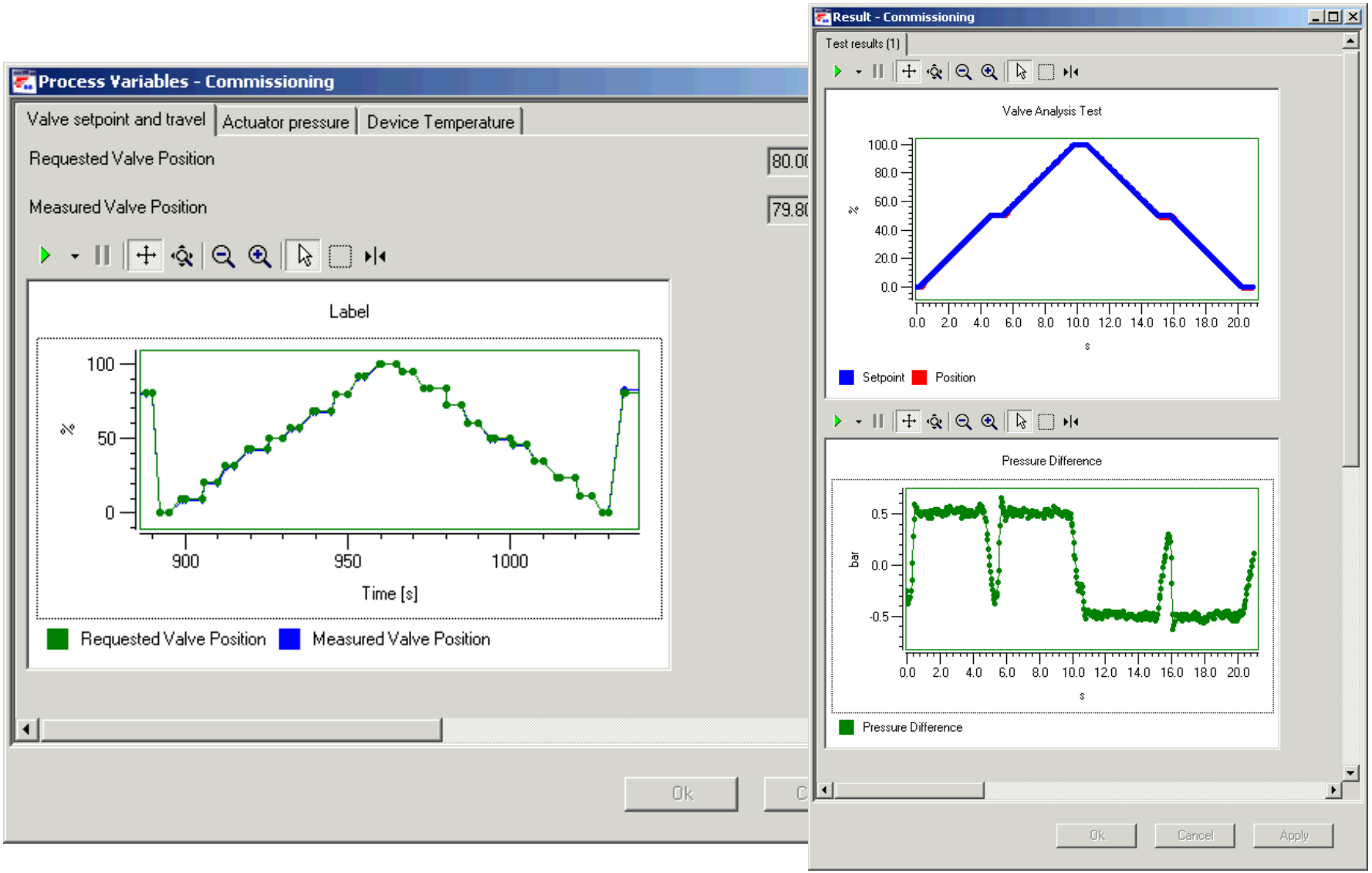


Easy to Understand User Interface



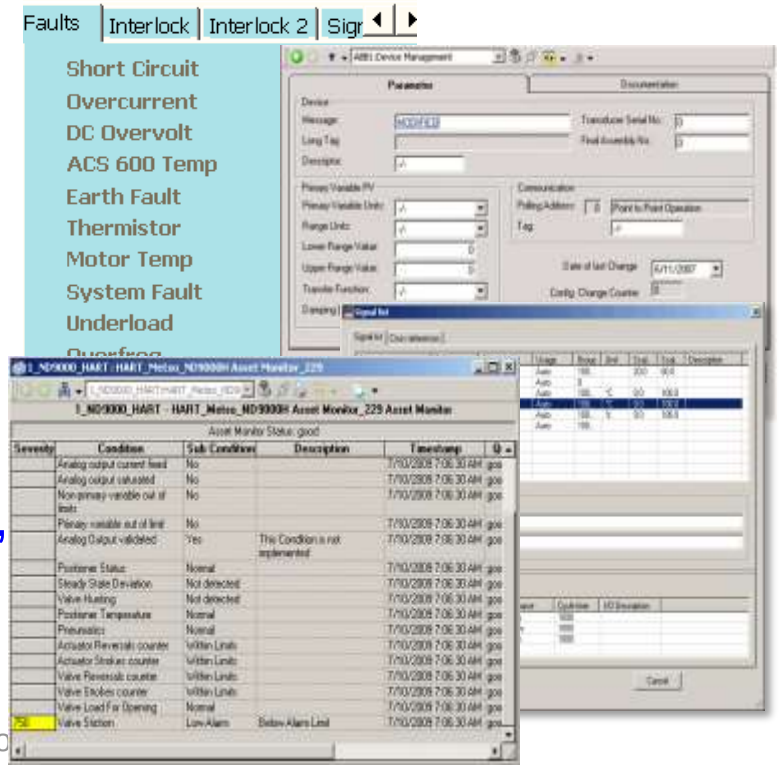
- New Properties Dialog for Block Parameters and DD methods
- Tree presents the DD menus and parameter groups
- Multi-windows support
- Methods accessible out of the Detailed Views

Display of Data-Intense Diagnostics Must Be Graphical

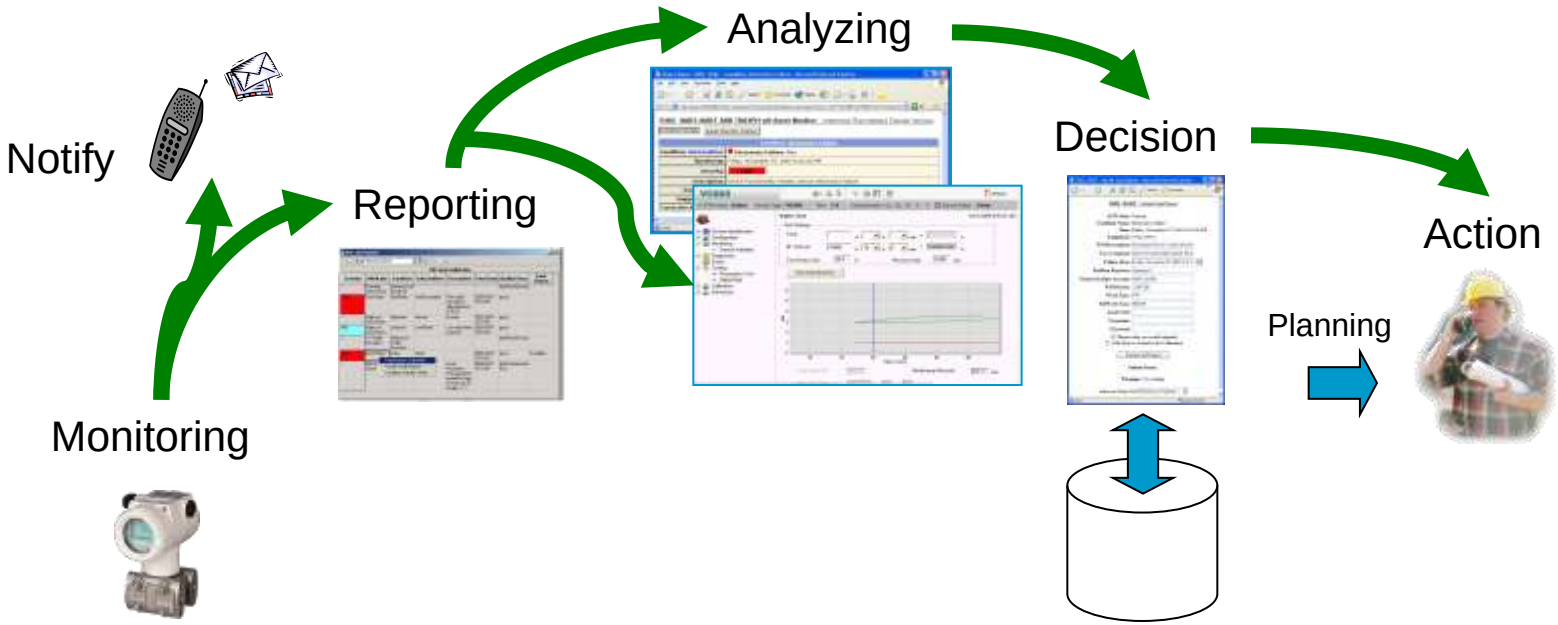


Work Processes Have to Be Re-written Around Device Management Software

- Standard company work processes for 4-20 mA and on/off signals which are not optimized for fieldbus
  - Operators cannot tell a device problem from a process problem
  - Technicians start by going to the field
- Make sure to re-write work processes around the device management software
  - Continuously monitor device health to drive predictive maintenance
  - Troubleshoot and verify from the device management software first, before going to the field, to improve



Maintenance Workflow with Device Management



Streamlined maintenance workflow
to make a faulty asset
in ***minimal time*** available for production again

Training for New Competency

- In the past the operators got training on the operator station software, but not the device management software
- The technicians got training on the handheld field communicator, but not the device management software
- Make sure to train operators and technicians on the device management software
  - How to search for tags, plant unit, device classes
  - How to search for specific device types

Conclusion

- Architecture
  - FOUNDATION fieldbus and other buses
- Workstation placement
  - Where technicians and operators see them
- Engineering is required
  - Prioritization, classification
- User interface guidance
  - Understandable, Diagnostic, Advisory, Focusing
- Work process change
  - Re-write

QUESTIONS?