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Benefits of IEC61804-3 Electronic Device Description Language (EDDL)

- Driving Superior Plant Performance

Abstract

The paper/presentation introduces the benefits of the IEC 61804-3 Electronic Device Description Language (EDDL) standard for device integration in driving superior plant performance.

End-users involved in commissioning, operations and maintenance will learn how EDDL-based control systems, software, and handheld communicators simplify calibration, advanced diagnostics and setup of simple and advanced device types communicating HART, Profibus, and Foundation fieldbus using powerful graphics and wizards. Find out how context sensitive help, illustrations, and other know-how provided by the manufacturer makes work easier as does look & feel consistency of content provided by device manufacturer. Learn how critical device diagnostics can be made available to operators on a need to know basis.

End-users responsible for system configuration and management will learn how EDDL-based solutions provide data synchronization between device manager and DCS, as well as automatic population of OPC servers. Find out how rigorous independent testing and registration process ensures interoperability between software and devices from many manufacturers. Learn how system investment is protected as files are not made obsolete by programs for new device versions, by Windows patches, service packs, .NET releases, or upgrade. Find out about simple integration of new devices and versions without software installation or overwriting files, or license key management.

Intelligent Device Management

Intelligent device management is an integral part of plant asset management. Apart from wiring savings, intelligent device management is the main promise of bus technologies such as HART, FOUNDATION fieldbus, PROFIBUS, and WirelessHART.

The Promise of Bus Technologies

Device management is based on live data from intelligent devices, as well as data stored in the software database.

Communication with intelligent devices enable commissioning, that is assignment of tag and address. Monitoring includes identification including tag, Device ID, manufacturer, serial numbers, versions etc. as well as general information such as materials of constructions, primary and final elements etc. plus dynamic monitoring of device internal parameters and logic. Diagnostics include simple sensor failures, loss of supply air, memory failures etc. as well as advanced performance analysis such as valve signature, step response, hysteresis etc. Operational statistics such as number of valve reversals, total travel, and power cycles etc. is also available. Configuration/Setup of device includes parameterization such as ranging as well as advanced setup such as radar level transmitter echo tuning. Comparison and reconciliation of device configuration against database is also possible. Loop testing and calibration trim can also be done.

Easily accessible data stored in database includes documentation such as datasheets, manuals, procedures, loop diagrams, P&ID etc. along with service notes which are permanent records of technician's observation. Device management software allows logging of calibration, inspection,

and service etc. and is stored in the audit trail together with all configuration changes. Audit trail reports can summarize any and all activities for traceability. Software displays a list of devices that are active, failed, and spares etc. Lastly there is scheduling for inspection/service and calibration.

These features are not just nice to have, they all translate into bottom line results for the plant as described in tables 1 and 2.

Table 1 live device data functions have benefits that translates into results

Function	Benefit	Result
● Monitoring – Identification – Information	● Faster device replacements	● Reduced downtime
● Diagnostics	● Faster fault detection ● Failure prediction ● Performance degradation detection ● No unnecessary maintenance	● Reduced downtime ● Lower cost of maintenance
● Configuration/Setup – Parameterization – Range – Calibration Trim – Simulation & Override – Device Security	● Better device setup and tuning ● Faster commissioning ● Faster replacement	● Improved quality ● Improved throughput ● Earlier startup ● Reduced downtime

Table 2 database information functions have benefits that translates into results

Function	Benefit	Result
● Service Notes	● Faster problem resolution	● Reduced down time
● Audit Trail and Reporting – Configuration changes – Maintenance	● Faster problem resolution ● Traceability	● Reduced down time ● Lower cost of regulatory compliance
● Maintenance Scheduling – Calibration – Inspection/service	● Higher device performance	● Improved quality ● Improved throughput ● Lower cost of maintenance
● Documentation	● Faster problem resolution	● Reduced down time

Improving output and lowering cost

Using device management software can increase output and lower the cost of operation

Monitor Performance and Reduce Process Variability

Process variability is a major culprit in poor plant output. When confronted with process variability, operator raise or lower the setpoint to get a comfort zone to avoid alarms if process variable goes beyond the specification limit. Using device management software it is possible to monitor device performance closely to detect sources of variability such as poor tuning. Subsequently device setup can be corrected reducing process variability. Once process variability is reduced, the setpoint can be moved closer to its optimum thereby increasing throughput. Similarly the quality will be more consistent.

All the Small Improvements Add Up

Process variability propagates through the process. If upstream feed is unstable or inconsistent, downstream process will be affected. The variability from different feeds and utilities add up for subsequent units and appear as inferior quality in the final product and overall inefficiencies.

However, performance analysis and device up-keep tightens up each individual loop and add up to higher quality and throughput.

Maintenance Cost Reductions Are the Low Hanging Fruit

Research data from the Dow Chemical company had found that 63% of the maintenance work orders resulted in no value added work. That's ghost chasing and going out to the field and checking things that were working. Devices connected through digital buses can be diagnosed remotely virtually eliminating such unnecessary work.

Operational Improvement

To sum up, operational improvement thanks to intelligent device management software comes from increased output from higher quality/yield, greater throughput, and higher availability (reduced downtime). The other part is reduce cost in terms of lower operations and maintenance expenditure, lower cost of safety, health, and environmental compliance as well as lower cost of energy, water, and other utilities and lower cost of waste and rework.

EDDL IEC 61804-3 Technology

It is not necessary to understand how EDDL works in order to use device management software. However, understanding EDDL is important for those who decide on which system to buy.

Need for Single Integrated Device Management Software

A plant may have devices from more than 10 different manufacturers and may have more than 100 different device types considering pressure, temperature, radar level, ultrasonic level, float level, magnetic flow, mass flow, vortex flow, ultrasonic flow, pH, ORP, chlorine, O2, density, valve positioners, electrical actuators, and others multiplied with a few vendors for each. Control loops may use FOUNDATION fieldbus devices, safety instrumented functions may use HART devices, and electrical use PROFIBUS-DP. Incremental monitoring uses WirelessHART. The technicians and operators cannot work with different tools for each type, manufacturer, or even protocol. It would be too many tools to manage and master. Therefore all these devices must be possible to manage (monitor, calibrate, configure/setup, and diagnose etc.) from the same single workstation software or universal handheld communicator.

Alphabet Soup

In the case of HART and FOUNDATION fieldbus this technology was originally known as "DD" since its creation 1992 while PROFIBUS called it "EDDL". When the IEC 61804 standard was approved, "EDDL" became the unified name for the technology. In 2006 the technology was significantly enhanced, while retaining the name "EDDL". There has been some confusion in the industry as to what EDDL can and cannot do. Limitations apply to the old technology, not the new, as illustrated in table 3.

Table 3 comparison of enhanced and original EDDL

	Original EDDL	EDDL with Enhancements
Alias	DD, DDL, EDD, DD v4	eEDDL, Enhanced EDDL, DD v5
Year	1992	2006
Logo	EDDL ELECTRONIC DEVICE DESCRIPTION LANGUAGE	EDDL™
Graphics	No	Yes
Menu	Limited	Yes
Persistent data	No	Yes
Standard	IEC 61804-2 Ed 1	IEC 61804-3

That Was Then, This is Now

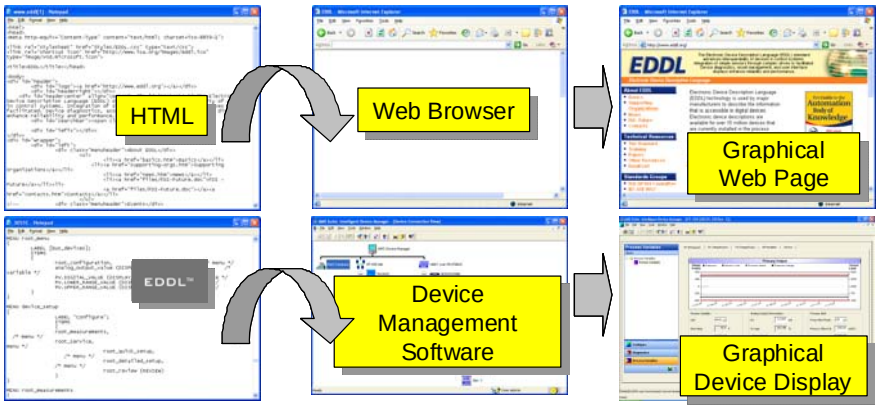
The original DD technology from 1992 was designed for plain text display and did not support graphics, sophisticated menu systems, or persistent data storage. However, the enhanced technology from 2006 does not have these limitations. Subsequently, the new technology can be used for advanced devices as well as for advanced tasks.

EDDL Technology

EDDL works in a way very similar to HTML web page concept. The EDDL text file is a description of the data in device in each device type. It tells the software which command to send to request data, how to decode the data when it comes back, and how to display the data to the technician. The software such as handheld or device management software that displays the data to the user is a form of "EDDL interpreter" working in the same was as a "web browser".

Works Like The World Wide Web

An HTML page is a plain text file, yet when loaded into a web browser it comes alive with rich graphics and easy to use. Complex functions are handled using Java scripts. EDDL works exactly the same way. EDDL is a plain text file which comes alive when loaded into a device management software, providing rich graphics making devices easy to use. Complex functions are handled by Java-like scripts called "methods".



Just like HTML made the Internet easy to use, EDDL with enhancements makes intelligent devices easy to use.

Device Integration & Plant Life Cycle

As devices get new features and other improvements, new device versions may become available every year. As failed devices are replaced, a new version of a device will come into the plant. If the plant has a large installed base of devices, a new version may come into the plant every couple of months or weeks. The system must be kept up to date to communicate with these devices. The system may have to remain operational for more than 15 years, during this period it must be kept "evergreen".

Intelligent device management software communicates send the right command to the devices to get the information. When information is received it must be decoded before it can be displayed. New devices have new features using new commands to be sent and new parameters to be decoded. Therefore, if a software was made for version 6 of a device it will not work for version 7.

EDDL solve this problem using a textual declaration of the device functionality without involving software. A file describes how to communicate with the device, how to decode the information, and how to display the information. This is the solution used by EDDL. This completely eliminates the risk of replacing working software components with non-working software components. Subsequently device management functions and process visualization can be done from the same workstation, allowing operators to see device heath and technicians to see process status.

User Requirements

What features are available to unleash capabilities in the intelligent devices is only a part of the requirements on a device management software. A major requirement is how to manage the system itself over the years.

NAMUR NE 105

NAMUR is an international user association of automation technology in process industries, where members pool experience, compile aids and check lists, setting user requirements on new devices, systems and technologies, and participating in standardization.
NE 105 is a recommendation for integrating fieldbus devices in engineering tools coming from workgroup 2.6. The emphasis is on the fact that investments must be protected by a stable interface between the application and operating system. An issue of considerable importance in the process industry is the fact that plants are operated for many years. Device integration technology must not reduce the lifespan of the system as a whole. Obsolescence resulting from the use of off-the-shelf IT products must be minimized.

Table 4 EDDL meets NAMUR NE 105 requirements

	Requirement	Remark
5.5	Multi-user synchronized clients	Multiple simultaneous clients must show the same data
5.4	Full support for device functionality	Graphics, persistent data storage, wizards, and handle dependencies
5.1	Single universal solution	Handheld field communicator, DCS database & control strategy building
4.3 4.2	Consistent display of devices	Regardless of protocol, manufacturer, or type
3.1	Investment protection	● Windows not made obsolete by files for new device versions ● Files not made obsolete by Windows patches, service packs, or upgrade ● Files not made obsolete by new software version ● Software not made obsolete by new device version
3.2	No component version conflicts	● One file shall not overwrite others: DLL-hell ● Shall not impact DCS robustness: DLL-hell
5.3	Operating system version compatibility	Files shall not be affected by Windows version, .NET framework, service packs, security patch, or different language packs
4.1	Easy device upgrade	Easy to load: no difficult software installation questions
5.2	No license keys	No license key hidden cost or management overhead
6	Interoperability testing	Independently tested with device

EDDL is Easy to Integrate and Update

Since EDDL is not software it cannot be license keyed. This makes managing the system based on EDDL easier. EDDL files come preinstalled on new systems. However, over time as new device types and new versions of devices come the plant it is necessary to load EDDL files for these. These files may come on a CD together with the device. It is also possible to download the EDDL file

from the manufacturer's web site or from the protocol organization's web site such as Fieldbus Foundation.

Full Support for Device Functionality

The 2006 enhancements to the IEC 61804-3 standard include graphical elements such as:

- Tabbed card
- Navigation area
- Pop-up window
- Image
- Trend chart
- Frame
- Gauge
- Bar graph
- Histogram
- Waveform graph
- Table

The original DD from 1992 met most the NAMUR NE 105 requirements. However, standard graphics had to be added to support configuration/setup and advanced diagnostics of sophisticated devices. The enhanced graphical user interface includes organized parameters, menu system, image, bar-graph, XY-graph, table, trend chart, and gauge. Interactive "wizards" to guide technician step-by-step can be created using methods, which are interpreted (not executed) just like JavaScript. EDDL with enhancements was approved as an international standard IEC 61804-3 in 2006

The graphics is rendered from keyword descriptions like HTML, it is not software. Therefore EDDL with enhancements retains all the benefits of the original DD technology.

Full Support for Device Functionality

Because EDDL with enhancements supports rich graphics such as images, waveform graphs, strip charts, gauges, bar-graphs, tables and menu systems including navigation tree, tabbed cards, and frames as well as interactive wizards based on methods, it can support a wide variety of devices from simple temperature transmitter to sophisticated variable speed drives for electrical motors, valve positioners, machinery health transmitters, and radar level transmitters to name a few. That is, all devices can be managed from the same single software or using the same single universal handheld communicator.

Ease of Use

EDDL wizards simplify complex tasks such as advanced setup and calibration trim. These wizards ensure correct procedure, including validating inputs, thus virtually eliminating mistakes.

Interactive Wizards: Field

Many tasks such as calibration trim, setup of advanced devices, and troubleshooting can be quite complex. However, using method scripts the device manufacturer embeds their know-how into a wizard taking the technician through a step-by-step procedure. This ensures the correct procedure is followed, thereby simplifying complex tasks, and eliminating mistakes. The wizard also simplifies setup procedures by only displaying valid options based on previous selections. Inputs are validated for plausibility.

Interactive Wizards: Desktop or Laptop

Methods work like JavaScript; interpreted, not executed. This ensures that EDDL files are secure. Just like JavaScript makes HTML pages interactive, methods make EDDL pages interactive.

EDDL Consistent Look and Feel

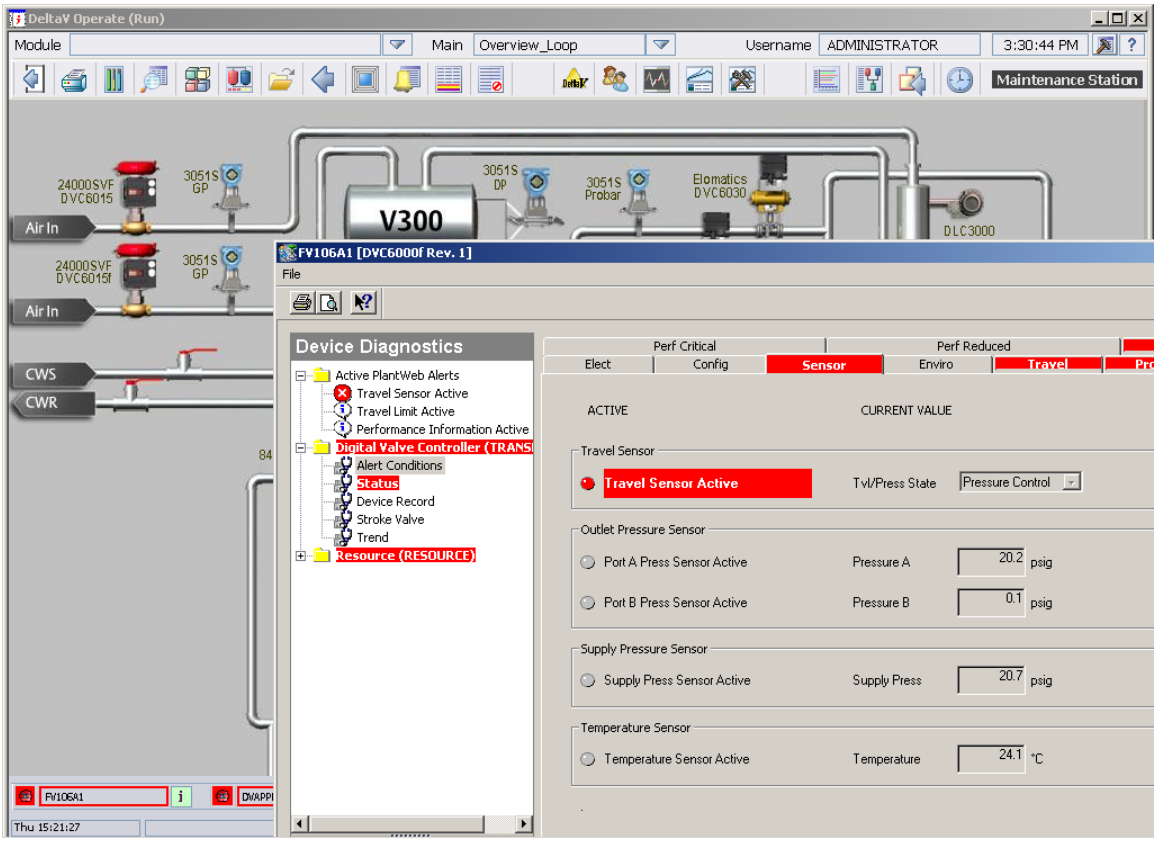
For EDDL, the display content and structure for the device is determined by the device manufacturer while the look and feel is determined by the device management software. That is, the device manufacturer can unleash all functionality and decide how the device should best be presented, for example if there should be a button on the display. However, the size and color of the button is defined by the device manufacturer to ensure that all buttons look and work the same way.

No Component Version Conflicts

EDDL with enhancements was designed to avoid component version conflicts. EDDL with enhancements is not software, just a text file. Therefore EDDL files are not installed. When a new device comes to the plant, its EDDL file is copied and pasted onto the computer. No files are removed for replaced. The working files for the older versions of the device remain in place and continue to be used for those older version devices still in the plant. This ensures that support for older version devices is not damaged when a new version device is added.

EDDL is Intrinsically Robust - Integrated Host

Installing software components may affect system robustness, but EDDL solves this problem by not being based on software. It is the simplicity of the textual description that makes EDDL more robust. That is, totally decoupled avoiding dependencies. Therefore device management software client can be installed on the operator console, enabling operators to check diagnostics of failed devices.



Cyber Security - EDDL Works Like HTML

Since EDDL is not executable software, loading EDDL files has lower risk. Moreover, loading EDDL files does not require 'administrator' level password to be widely known. Just like HTML, EDDL with enhancements was designed to avoid this problem. EDDL and HTML are both documents, and documents are not executed. Display is rendered according to keywords in the file. An EDDL file can contain method scripts similar to JavaScripts in HTML pages, but both methods and JavaScript are interpreted rather than executed and therefore not a security risk.

EDDL is Universal

In addition to device management from workstation or laptop software, EDDL also supports the control system for configuration and is used in handheld field communicators and even embedded gateways.

Supports System Configuration

EDDL enables control systems to build FOUNDATION fieldbus control strategies. Fieldbus loops cannot be configured without EDDL. Moreover, EDDL simplifies external access to device data as EDDL enables automatic OPC server configuration. The FOUNDATION fieldbus is part 2 of the same standard as EDDL.

Handheld Field Communicator

EDDL with enhancements works on embedded operating systems. Just like HTML, the EDDL file is operating system independent and can therefore run on embedded operating systems such as Windows CE or Linux. EDDL also makes no assumptions about display size or color capability. Therefore EDDL is suitable also for universal handheld communicators. As the name suggests, a universal handheld field communicator can easily be held with one hand while working with the other. It is also ruggedized to take some shock and is splash proof. Of course it is also possible to use EDDL on a laptop/tablet in order to enjoy the full graphical capability of the Windows environment. Many EDDL-based applications are also suitable for use on a laptop/tablet.

EDDL is a Complete Plant Life Cycle Solution

An EDDL-based software is a complete solution for all phases of the plant life-cycle, handling all different tasks using a single technology. EDDL need not be "complemented".
Design and Engineering In the control system engineering workstation EDDL is used to configure the FOUNDATON fieldbus function block control strategy.
Installation and Commissioning As devices are fitted in the field they are commissioned using a universal handheld field communicator
Operations In the control system engineering workstation EDDL is used to monitor internal parameters and for remote diagnostics
Maintenance In the field a universal handheld communicator uses EDDL for troubleshooting

Operating System Independent - Not Affected by Windows Upgrades

EDDL, just like HTML, is totally independent of Windows. That is, Windows software is not part of the interoperability. Therefore EDDL files are inherently immune to Windows upgrades. No special management procedures need to be in place for the EDDL files. EDDL files are unaffected by operating system upgrade, service pack, or security patches. New versions of Windows can be adopted sooner. EDDL files created for devices in 1992 still work today, that is, investment is protected.

Multi-User Synchronized Clients

EDDL speeds up commissioning and other tasks by allowing many persons to work at multiple workstations simultaneously without conflicts.

EDDL Protects Investment

EDDL solves the obsolescence problem because it works like HTML, it is not software. A new version of Windows has no impact on an EDDL file at all because it just a text file. A text file is a text file on any version, service pack, or security patch for Windows. A new device still provides the same kind of EDDL file. New device management software works with EDDL files from 1992 up to today. Just like web browsers can look at web pages created in 1994. When computers are upgrading, loading the EDDL files is a simple copy and paste operation: drag-and-drop, without further human interaction.

EDDL Requires No License Keys

EDDL reduces cost and time by reducing the need to pay for and manage license keys

EDDL Interoperability Testing

EDDL file is tested with device protocol as part of the device interoperability testing. This validates the file against the actual device, thus ensuring high quality and reliability of interoperability.

EDDL is The Only International Standard

IEC 61804-3 and -4 are the only international standards for device integration. EN 50391 is the only European standard for device integration. ANSI/ISA 61804-3 and -4 are the only US standards for device integration.

User Guidance: Documentation and Context Sensitive Help

EDDL dramatically improve the productivity of technicians by providing instant access to documents that they otherwise would have had to cover considerable distance to get to, or take valuable time from other plant personnel to find answers for them.

Common Standard Functions

Use is further simplified because EDDL software have common standard functions such as for download, value comparison, context sensitive help, and printing etc.

Externally Accessible Information

Because EDDL is a descriptive technology (like HTML), the description of the parameters in the device can also be used to automatically populate the namespace and item attributes in an OPC server. That is, EDDL can be used not only to show values on the screen, but can also be used to make values accessible to external applications. This may include for example historians, statistical process control, tuning, etc. Moreover, the configuration of the server which is usually the most tedious work for OPC, is done automatically.

Accessible Information - Works like HTML

EDDL does not “do” anything with data just like HTML does not “do” anything. EDDL, like HTML, just makes data available. HTML itself cannot print, save, or export to Excel. It is the web browser that does all of those things by decoding the HTML file. Similarly, EDDL does not print, save, export, or log - it is the device management software that does all of those things by decoding the EDDL file. This also means that new software can in the future add new functionality and this also applies to the old devices because old EDDL files need not be changed.

System Life-Cycle Management

EDDL meets all the NAMUR NE 105 criteria. Because of these strengths is why EDDL has been in place for 15 years and with new enhancements continue to go strong

BIS - Independent Evaluation of EDDL

BIS Prozesstechnik (subsidiary of Bilfinger Berger Industrial Services) conducted a detailed independent study entitled "*Applicability & Usability of Enhanced EDDL (IEC61804-3) when applied to typical Use Cases in Process automation*" using devices and control systems from different suppliers to see if the EDDL meets the requirements in NAMUR recommendation 105 for field device integration in engineering tools, in which the way is the IEC 61804-3 standard is used by device and control system manufacturers, and which advantages has the new EDDL standard has for plants in the commissioning, operation, and maintenance phases of the life-cycle.

A wide range of device types were tested including everything from the simple temperature and pressure transmitters to sophisticated radar level transmitters, valve positioners, and frequency

converters (variable speed drive) connected via HART, FOUNDATION fieldbus, PROFIBUS DP and PROFIBUS PA bus systems.

Sophisticated devices such as radar level transmitters provide user-guidance in the form of quick start wizards and include illustrated information such as tank shape images simplifying parameterization and support persistent data storage.

The study found that EDDL meet the requirements also for complex devices, further software tools are not required. EDDL wizards, images, and trend charts enable good usability and intuitive operation also for complex use cases (e.g. Partial Stroke Tests). The study also found that loading EDDL files had no influence on the stability on the control system also during run-time and that all devices were interoperable thanks to certification tools and process. The enhanced EDDL graphical support features grants an intuitive device operation and support for all device functions. Further more, all basic functions have a common look and feel for all devices as required by the NAMUR recommendation.

Incorporation Into Daily Work Practices

If the device management software sits unused and logged out in the corner or the control room, or perhaps even switched off in the local equipment room, the results will not be achieved. It will be a white elephant.

Ensuring Adoption of Device Management Software

Diagnostics allows operators to take evasive action to minimize the process impact of a failure. Having to review the nature of a device failure from another workstation would be like having to work on email and browse the Internet from two different computers - productivity would be lower. Only on systems built on EDDL is it possible to see device diagnostics graphically on the operator workstation.

System Architecture - Integrated, yet Separated

Operators must be able to make the right decisions in response to device failures because it affects their process. They therefore need to see diagnostics from devices which have actually failed, yet not be overloaded with data which is predicting future failures but which have not yet materialized and therefore not affect their process yet.

If device management is done from a separate workstation, device diagnostics cannot be reviewed from the operator station, the operators must write down the tag, move over to the maintenance workstation, login, and look up the tag in the device management software. At some sites the maintenance workstation was not even in the same building as the operators. It will be eventually be switched off.

Because EDDL is not software, EDDL files can be loaded on the DCS. Therefore operators can see failure diagnostics at the click of a button. This is essential for it to be incorporated into daily work processes. The server part of the device management software typically runs on a asset management system server computer. Only the much lighter client part of the device management software runs the operator workstation. Thus operator stations or control system servers are not overloaded. Experience shows that when integrated it is used much more and become part of daily work practices while separated falls into disuse and eventually may even be switched off. Operators are not be able to reconfigure devices and technicians are not able to make changes to the process, although they can optionally see it as view-only.

Diagnostics Filtering

There are a few possible philosophies for managing diagnostics alarms:

1. Do not inform operators about device problems at all, even though a device failure affects the process.
2. Inform operators about actual device failures affecting the process now, but not disturbing them with predictive alerts. This is the sweet spot: actual alarms in operation and maintenance. Predictive only in maintenance station
3. Inform operators about all alerts, including predictive diagnostics that do not affect operation yet.

Most would agree critical conditions like failure diagnostics affecting the process must be signaled to the plant operator immediately so they can take the appropriate action. Predictive alerts which have not yet materialized into failures and therefore don't affect the process should only be signaled to the maintenance technicians in order to schedule maintenance. The appropriate operator action to each device diagnostics alert for each control loop is documented in plant specific work processes.

Integrated Architecture - Capability vs. Skill

Not every alarm in every device is shown to operators. They are filtered. Just failures that affects operations requiring action to be taken to avoid problem or to continue operation. Not predictive which are not yet failures. Operators are not be burdened with predictive maintenance alerts for device diagnostics because it is not yet a failure. However, if there is a failure the operator should know about it because it affects the loop, and likely the process unit too, and possibly the plant. The operator cannot fix the device, but can take evasive action and operator can alert technician.

Table 5 personnel can only access what they are responsible for

	Operator Station	Maintenance Station
Operations	Yes	No (Optionally view-only)
Diagnostics	Yes (Failure only)	Yes
Setup / Configuration	No	Yes
Monitoring	No	Yes

Conclusion

Intelligent device management software incorporated into the daily work practices improves output and lowers cost. EDDL is the key to interoperability, enabling intelligent device management. In addition to have many features to support devices, the device management system itself must be easy to manage.

Reference

NAMUR NE 105 "*Specifications for Integrating Fieldbus Devices in Engineering Tools for Field Devices*"