Contribution of Asset Excellence to Sustainable Plant Operations

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Smart field instruments have been used in process plants for more than 40 years. The pace of implementation accelerated in the early 21st century when full-scale smart field instruments became essential for the construction of new large-scale process plants. However, the various tools used in the past to manage smart field instruments could not take full advantage of their potential. A new category of automation system, called plant automation management system or asset management system, became the de facto basic component of process automation systems. Yokogawa Electric Corporation’s answer to this market demand was Plant Resource Manager (PRM), which was released in 2001. Subsequently, a suite of products and services was developed, and Yokogawa launched the Asset Excellence initiative in 2006 to help users realize operational excellence. Today, PRM is one of the core solutions offered by Yokogawa’s new OpreX Transformation brand for asset management and integrity. This paper explains the three main product features of PRM from the perspective of the Sustainable Development Goals (SDGs): (1) centralized asset management; (2) device lifecycle management; and (3) diagnostics for predictive maintenance. This paper is intended for readers with a background in industrial automation but who may not be familiar with PRM. The paper will give readers a good understanding of the product features of PRM and their relation to the relevant SDGs.

INTRODUCTION

Yokogawa Electric Corporation offers a suite of automation solutions called Asset Excellence (AE), which consists of the hardware and software solutions shown in Figure 1, for realizing step-by-step sustainable plant operations as follows.

- Yokogawa field instruments, CENTUM VP and ProSafe-RS control systems: hardware that forms the foundation of highly reliable automation assets
- FieldMate: a field tool that facilitates the configuration of a single device and performs device operations such as parameter setting, maintenance, and diagnostics
- Plant Resource Manager (PRM): a tool that facilitates extensive remote status supervision of plant facilities from a central control room and performs device operations such as parameter setting, maintenance, and diagnostics
- Insight Suite Asset Excellence: a suite of value-added service tools and consulting services that enables users to propose new ways of improving their plant operations

Figure 1 Asset Excellence services and their benefits for realizing sustainable plant operations

PRM is a key platform product among Yokogawa’s AE that facilitates the optimization of plant assets through operations and maintenance activities. Although it was developed before the global disclosure of the Sustainable Development Goals (SDGs), AE’s key features are closely aligned with the aims of the SDGs (Figure 2).
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RELATIONSHIP OF ASSET EXCELLENCE WITH THE SUSTAINABLE DEVELOPMENT GOALS

In process plants, thousands of field instruments are installed in hazardous production environments. Centralized asset management facilitates consistent remote management of such devices from an office environment. This management scheme contributes to Goal 8 of the SDGs, which calls for decent work and economic growth, by reducing labor-intensive field work and exposure to harsh production environments.

PRM supports the lifecycle management of field device technology that has evolved over the past few decades as well as new Industrial Internet of Things (IIoT) devices. PRM facilitates sustainable long-term plant operation by preserving users’ existing asset investments and enabling future asset expansion. This contributes to Goal 9 of the SDGs, which calls for the development of quality, reliable, sustainable, and resilient infrastructure that supports economic development.

PRM continuously monitors the health status of all field instruments. Advanced diagnostic algorithms and applications provide insight into device performance and predict failures to assist preventive and predictive maintenance. This contributes to Goal 12 of the SDGs, which calls for responsible production and consumption.

Field Devices Connected to Third-Party Systems

For field devices connected to a third-party control system or I/O gateway, PRM supports the widely adopted FDT/DTM technology (IEC62453 standard) that provides a standard means to easily access intelligent device information independent of the field communication protocol or control system. Without a centralized asset management system, those devices must be managed at the device level or by using a third-party control system.

PRM integrates all major fieldbus device protocols, including HART, Foundation Fieldbus, ISA100 Wireless, and Profibus PA/DP (Figure 3). By establishing a communications link with these intelligent devices, plant operators can perform remote management without needing to send maintenance staff to the actual devices, which are usually located in a harsh production environment.

The centralized remote asset management function of PRM substantially reduces the workload and improves the working environment of plant operators. Conventionally, field technicians carry tools up and down ladders to access local field instruments, whereas PRM enables plant operators to do the work from a computer terminal in an office instead. Productivity is also greatly enhanced because many assets can easily be managed by fewer staff than is possible when devices must be accessed locally or from multiple systems. Therefore, this core PRM function contributes to achieving Goal 8 of the SDGs (Decent Work and Economic Growth).

CENTRALIZED ASSET MANAGEMENT

The core feature and main value of PRM is its ability to centralize the asset management of plant automation equipment under a single system.

In most plants, thousands of devices supplied by different manufacturers may be directly connected to different control systems. Without a centralized asset management system, those devices must be managed at the device level or by using a third-party control system.
system supplier. This enables PRM to manage all the field instruments within the facility under a single centralized system.

Integration of Other Production and Automation Assets

PRM allows online monitoring of field devices connected via fieldbus. In addition, PRM facilitates monitoring of plant equipment by connecting the diagnostic functionality provided by other companies via a standard Open Platform Communications (OPC) interface. PRM monitors the operating status of rotating equipment such as compressors, as well as instrumentation devices, in conjunction with System 1 from Baker Hughes (previously General Electric). PRM can be flexibly configured to map equipment status from any third-party control system that supports an OPC interface. For example, an intelligent motor system managed by an electrical control system can be monitored in PRM via this interface.

DEVICE LIFECYCLE MANAGEMENT

The lifespan of industrial facilities that employ asset management systems such as PRM is typically several decades. Devices installed at such facilities usually go through several rounds of configuration changes, replacements, and upgrades before the facility reaches the end of its service life.

PRM not only provides features that support the individual lifecycle stages of a device throughout its lifespan, but also adapts to the evolution of fieldbus technology, ensuring that different generations of technology can co-exist in the same system. The latter function is both the greatest challenge and the greatest contribution of PRM toward achieving long-term stable plant operations.

Accordingly, the device lifecycle management of PRM contributes to achieving Goal 9 of the SDGs (Industry, Innovation and Infrastructure).

Commissioning

Plug and play

The first step in commissioning a field device is to register the device in PRM. The plug-and-play function detects devices connected to PRM and registers them in PRM automatically. This feature drastically reduces the commissioning time by automatically scanning, detecting, and registering field devices in PRM.

FieldMate synchronization

FieldMate is Yokogawa’s local device configuration tool used to configure devices one by one in a factory or workshop. The device information configured by FieldMate before the device is installed in the plant can be imported from FieldMate to PRM by using the Fieldmate/PRM Synchronization tool, which combines the workshop device information history with the online device information.

Configuration Change

Once the communications link to the device is established, PRM provides various device configuration tools for changing device parameters, performing calibration, and testing.

Parameter Manager

Parameter Manager acquires or modifies intelligent devices’ parameters online. The parameters of an individual device can be altered or the saved parameters can be downloaded to multiple devices simultaneously.

Device Type Manager (DTM)

DTM is a parameter-setting tool supplied by device manufacturers that allows users to employ elaborate settings and an advanced graphical user interface for device commissioning.

Audit Device Parameters

Because most field devices have hundreds of parameters, it can be challenging for maintenance staff to notice when some parameters are not configured as intended. The Audit Device Parameters tool can validate incorrect parameter values in scenarios such as setting up a new plant, replacing devices, or shutting down a plant for maintenance. The tool enables users to compare the actual parameter data of a device or the last saved parameter set with the master reference parameter set. It can also compare the device template set data for a group of field devices. The audit results are exported to an Excel file in which detected differences are highlighted, as shown in Figure 4.

Figure 4 Audit Device Parameters report

Replacement and Upgrading

Device inheritance

When replacing devices connected to the field network, such as when replacing a failed device or swapping out a device temporarily for inspection or calibration, users need to update the information stored in PRM by registering the new device. The device inheritance function allows the new device to inherit the device information from the replaced one, thus shortening the replacement time and allowing normal plant operation to be quickly resumed.

PRM system upgrade

Smart field instruments using digital communication protocols such as HART have been used in the process industry
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since the mid-1980s. Newer pure digital communication protocols such PROFIBUS and Foundation Fieldbus have emerged since the 1990s. Today, wireless technologies such as ISA100 and Wireless HART are becoming more widespread. Technology that unifies the various proprietary approaches to automation such as FDT/DTM has been recognized as the de facto standard in the market since the 2000s. The advantages of FDT have evolved, leading to the creation of Field Device Integration (FDI) technology over the last few years.

PRM has kept pace with these technological evolutions. Each new version of PRM maintains backward compatibility and ensures that devices at different points in their respective lifecycles can co-exist within the same system.

DIAGNOSTICS FOR PREDICTIVE MAINTENANCE

The key benefit of investing in smart field instruments is higher maintenance efficiency. Smart field instruments can perform self-diagnostics and alert plant operators to take preventive maintenance action before failure occurs.

In addition to basic self-diagnostics, smart field instruments have many device operating parameters that can provide insight into the long-term reliability of device operation. PRM utilizes such information from smart field instruments to provide both basic and advanced diagnostic functionality. This enables plant operators to develop a preventive maintenance strategy and reduce unexpected failures of devices and equipment, which can lead to production losses, material wastage, and even accidents that impact people and the environment.

Accordingly, the predictive maintenance feature of PRM contributes to achieving Goal 12 of the SDGs (Responsible Consumption and Production).

Basic Diagnostic Function
Device patrol and alarm notification

PRM performs periodic status checks or receives event notifications from devices. It then displays a summary and the individual details of the devices and equipment according to the plant’s hierarchical levels, allowing operators and maintenance technicians to ascertain the status of plant equipment and instrumentation at a glance. In the event of equipment failure, PRM notifies operators and maintenance technicians, providing the details of the problem, the causes, as well as recommended countermeasures and preventive actions.

Advanced Diagnostic Function
Partial stroke testing

Partial stroke testing (PST) is a methodology for verifying whether the emergency shutdown (ESD) valves, which are responsible for executing a safe shutdown during hazardous process conditions, are functioning effectively. PRM facilitates the periodic scheduling of PST and can perform PST automatically or semi-automatically with the acknowledgement of plant operators. PRM displays the test schedules, test progress, and test results.

Using this function, the plant can continue to operate without disruption while performing a full ESD valve test, as well as improve safety by conducting more frequent partial tests.

Advanced diagnostic application

The advanced diagnostic application of PRM utilizes device parameters and process data information to perform diagnostics on devices and equipment. It also enables users to implement customized diagnostic algorithms in a flowchart style. For instance, when applied to a valve positioner, the advanced diagnostic function could acquire the number of valve strokes to help maintenance technicians determine when to service the valves before performance starts to degrade.

CONCLUSION

Today, more and more people recognize the potential for the vast amounts of data collected by sensors and actuators to contribute to the digital transformation, which is one of the driving factors behind the SDGs.

The next generation of IIoT devices will enable much faster communication, which in turn will allow greater volumes of data to be accessed from the internet. This will have a profound impact on the architecture of process automation systems because the traditional sensor, control system, and asset management system hierarchy will no longer be relevant.

The SDGs are a high-level abstract social development concept that may prove difficult to relate to individual products and technologies. This article introduced a few major features of PRM and explained their relevance in terms of the SDGs. By understanding how PRM can contribute to the advancement of society and realization of the SDGs, those involved in the development and application of this product and its related technology can derive greater satisfaction and motivation from their work. Under the all-new Yokogawa OpreX brand, AE solutions such as PRM must continue to adapt to the latest trends in technology and co-create value with customers in order to support them in their goal of realizing sustainable plant operations.

REFERENCES

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