INCREASED PLANT EFFICIENCY BY ONLINE PLANT ASSET MANAGEMENT

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Abstract:
Asset management in industrial plants has become an important factor for cost efficient production by helping to reduce the effort for maintaining the plant and the plant instrumentation. This results in a higher availability of the production.

The highest possible benefit for the customer can be achieved if the asset management is based upon real-time processing of the information already available in the process control system. The integration of the asset management in the process control system is the logical realization of this requirement and creates additional advantages like uniform look and feel, uniform engineering and reduced engineering effort.

Keywords: Maintenance, Diagnosis, Process Control, Asset Management, Maintenance Management

1. INTRODUCTION

Industrial automation means "to gather and process information and finally to intervene in the technical process to ensure that the desired process result is achieved automatically". Most process information is acquired by measuring devices that capture and transform the current condition of the technical process and of the production facilities.

Both the information gathered and the data generated by processing this information is visualized for plant personal because they are responsible for all decisions concerning the process management.

To ensure that tight control is kept on processes despite the huge volumes of information involved, the process control system must provide suitable functions to support plant staff. These include the intelligent preprocessing and structuring of information so that employees are shown only the information they need to perform their tasks in a given situation.

Online plant asset management is the most innovative and important example of task-based processing and structuring. Modern process control systems such as SIMATIC PCS 7 from Siemens provide users with these features.

2. ONLINE PLANT ASSET MANAGEMENT

2.1 What is Online Plant Asset Management?

Asset management – a term borrowed from business administration – is concerned with the management of the fixed and current assets of an enterprise. Production facilities are part of the fixed assets, together with plant components such as equipment, machinery, piping, etc. and the instruments and process control technology instruments and equipment (Namur, 2001).

In the context of production, asset management embraces "all activities and measures designed to maintain or increase the value of a plant". In addition to plant and process management and process optimization, the major focus is placed on maintenance operations that maintain and increase the value of plant assets (Namur, 2001).

This draws attention to the fact that although maintenance tasks are necessary to ensure maximum availability of production facilities, their economic

relevance has to be taken into consideration too. Therefore, an integral task of online plant asset management is the optimization of maintenance in terms of costs and benefits. Preventive maintenance, inspection, repair, and plant improvements are concrete measures for this optimisation (Namur, 2001).

2.2 Goals of Online Plant Asset Management

Online plant asset management enables plant operating companies to determine and assess the condition of their assets, i.e. production facilities and their components, so that appropriate action can be taken if the desired or expected condition is not achieved. Direct parallels can be drawn between asset management and medical check-up programs or medical diagnostics.

In the latter case, the asset is a person whose state of health is to be assessed. This is done by measuring and monitoring, for instance, body temperature to identify symptoms or signs of illness and to arrive at a diagnosis (e.g. influenza). Once a diagnosis has been made, suitable treatment is prescribed. The treatment has a positive effect on the person and removes the cause of the illness, thus completing the cycle (Figure 1).

The same principle applies for technical assets. Monitoring, i.e. gathering and analyzing process parameters, allows the condition of an asset such as a field instrument to be ascertained. A typical "symptom" may be that no signal is being received from a sensor element. The diagnosis is that a "line break" has occurred. This triggers a maintenance request which results in the repair or replacement of the broken line. This action – replacement of the defective component – removes the cause of the asset problem and completes the maintenance cycle.

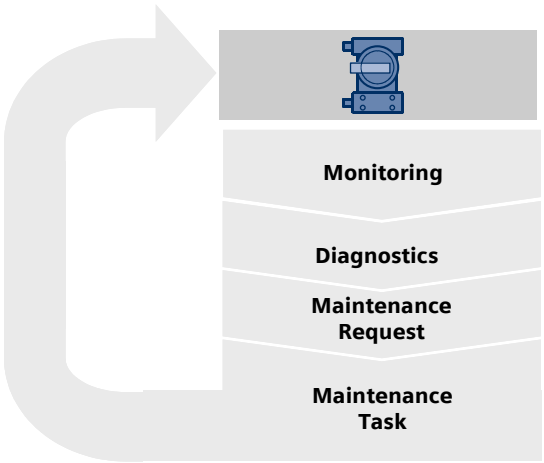

Figure 1: Maintenance cycle

Various maintenance strategies (EN13306, 2001) are available (Figure 2) depending on whether a reactive or proactive approach is adopted. In the case of corrective (failure based) maintenance, actions are not initiated unless a fault – or to return to the medical analogy above an illness – has occurred. A proactive approach would be to implement preventive maintenance. The goal of such a strategy is to introduce maintenance measures before faults can occur. This strategy can be implemented by means of time-based actions such as regular maintenance or by condition-based actions that depend on levels of wear and tear. A predictive strategy enables problems to be identified before they occur and provides users with information on remaining useful life.

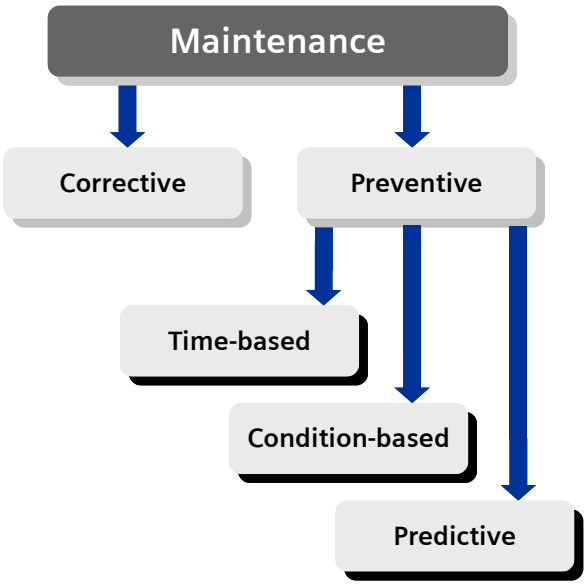

Figure 2: Maintenance strategies

Of course, online plant asset management supports not only corrective maintenance – as exemplified above – but, above all, preventive maintenance. The response to a maintenance request can therefore take the form of corrective maintenance (e.g. repair or replacement) or preventive maintenance that is

- time-based
- condition-based, or
- predictive

In summary, online plant asset management achieves the following goals.

- The condition of assets is captured and assessed
- Actions are initiated to eliminate or prevent problems
- Support is provided when such actions are implemented.

2.3 Implementation in a Process Control System

To achieve these goals, a suitable system is required for practical deployment of online plant asset management in real-world scenarios. This system features the necessary functions and provides users with interfaces for operating and monitoring these functions. The requirements (Namur, 2001) of the user community have been clearly formulated in particular by NAMUR, an association of users of process control technology in the chemical and pharmaceutical industries. Primary requirements are as follows.

- Online plant asset management must be part of the process control system
- The condition of assets must be captured and assessed in real-time
- All assets must be covered (field devices, all other process control technology instruments and equipment as well as plant components)
- Process information and maintenance-relevant information must be separated
- Visualization must be standardized for all assets
- There must be no restrictions as to the choice of field devices

The user community (Namur, 2002) also requires that all field devices provide standardized messages on their state as follows:

- Good
- Failure
- Check request
- Function check

How the goals of online plant asset management are achieved and how user requirements are satisfied in practice is illustrated below by reference to the SIMATIC PCS7 process control system.

A pyramid as a model that divides the functions, systems and components needed for automation into hierarchical levels has long since proved its value (Namur, 1996). The number of levels differs according to the scenario in which the model is applied. A common model assumes a division into three levels: ERP (Enterprise Resource Planning), MES (Manufacturing Execution Systems) and controls (process and field level) as shown in Figure 3. Maintenance, and therefore online plant asset management, can be classified into levels in exactly the same way as automation is divided into hierarchical levels.

As in automation, values are measured and preprocessed on the controls level in the maintenance pyramid so that the condition of the assets can be determined and, depending on results, maintenance requests can be forwarded to the higher levels. The functions used to plan and coordinate the measures to be implemented are located on these higher levels.

Despite the different tasks it is advisable and necessary to map the functions of these two pyramids onto a single process control system and not onto separate systems (Figure 3). The reasons for this are as follows.

- The same information sources (field devices) are relevant for automation and for maintenance.
- The automation functions and the asset management functions are closely interleaved because, for example, the current mode of operation of the plant influences the assessment of the asset condition.
- Engineering data for automation can also be used for maintenance.
- System handling is simplified because all involved plant staff use the engineering, operating and monitoring tools of a single system rather than working with several systems.

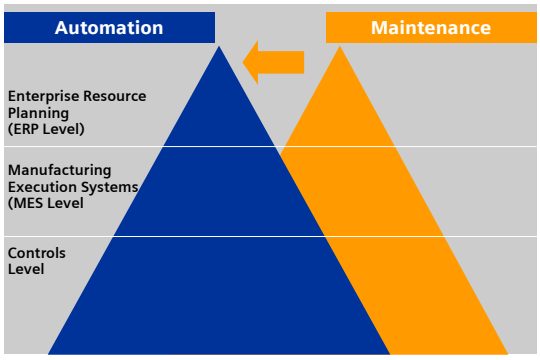

Figure 3: Online plant asset management with a single process control system

Although automation and online plant asset management run on the same system, information is separated according to the two user groups (operators and maintenance technicians) so that neither group is overburdened with information. A maintenance station (MS) therefore supplements the operator station (OS) (Figure 4). On the operator station the operator has access to all process-relevant information and can manually intervene in the process. However, information relevant to maintenance is withheld from the operator station. Maintenance information on all automation equipment components is bundled and presented to the maintenance technician at the maintenance station. The same operating and monitoring tools are used at the operator and maintenance station and the operating and monitoring philosophies are absolutely identical. The only difference is the information content which is designed to suit the different needs of the operators and maintenance technicians.

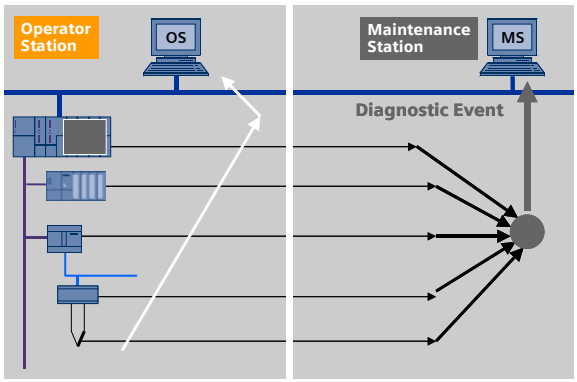

Figure 4: Separation of information according to user group

Implementing online plant asset management directly on the process control system has the inherent advantage that there are no restrictions as to the choice of field devices because all devices that can be connected to the process control system are automatically included in online plant asset management.

Given the very large number of assets in a plant, it is particularly important to minimize the additional effort required for engineering online plant asset management. In addition to "technology" planning, a separate diagnostics area is set up to map the plant from a maintenance view (Figure 5).

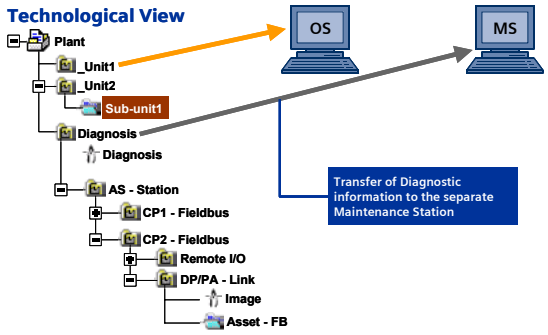

Figure 5: Plant planning from a technology and maintenance view

The diagnostics area that is hierarchically structured in accordance with the device topology includes the field devices and other components of the automation equipment such as automation stations or field buses. This area is generated automatically from the existing hardware engineering and no additional manual activities are required. Nevertheless, the diagnostics area is fully accessible so that users can make application specific changes. The two areas are transferred to the two stations where separate information is provided for the different user groups. The technological view is assigned to the operator station (OS) and the diagnostics area to the maintenance station (MS).

To obtain a clear picture of assets at all times, despite the volume of information, and to ensure that their condition can be accurately assessed, assets are shown using a set of uniform icons (Figure 6). For instance, there are symbols for the condition of the device itself and for the importance of a maintenance request (request status). The status of maintenance actions initiated is also shown. The uniform icons reflect the status of all assets including not only automation devices and equipment but also plant components.

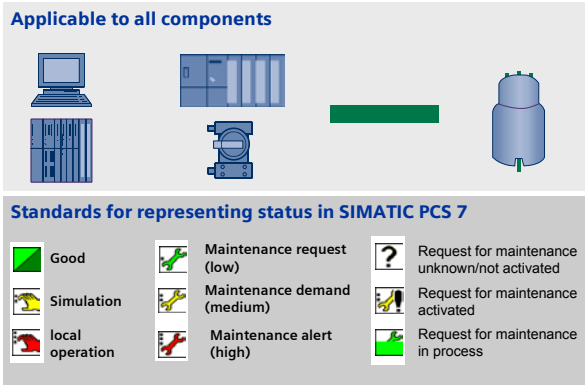

Figure 6: Uniform icons for the condition of assets

To control the flood of information not only a uniform set of icons but also the hierarchical structuring of information is important. is. This enables maintenance technicians to start with an overall (plant) view and to drill down to asset details, if necessary. In the overall view the uniform icons visualize the condition of the asset itself and provide in collective form the condition of all assets on the lower levels of the hierarchy not shown in the overview (Figure 7). The collective status signal is similar to a set of traffic lights where the colors red, yellow and green indicate a "good" condition or the severity of a potential problem. The condition of the plant can therefore be assessed at a glance.

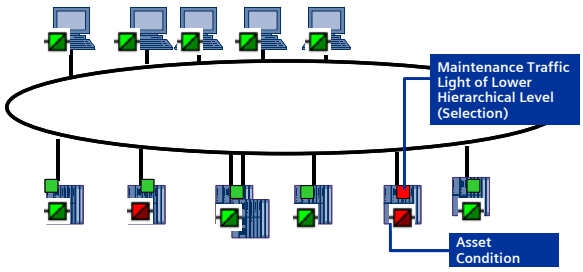

Figure 7: Hierarchically structured visualization of asset information

Selecting the symbol for collective information on lower-level assets causes a branch to be made to the next hierarchy level down with the same look-and-

feel as the overall view. On this level maintenance technicians already have access to the asset or must branch to even lower hierarchy levels. All information on an asset is displayed in a sub-screen (Figure 8) that is called by selecting the asset symbol in the overview or in a lower-level view. The sub-screens also have views that are structured according to content.

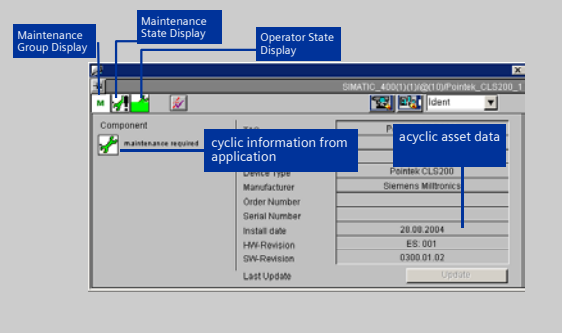

Figure 8: Asset sub-screen

Figure 8 shows an example of an "Identification" view that displays the current status information of the asset as well as vendor- or plant-specific data assigned to the device. This data includes the unique identification of the device. There are also additional views that contain

- detailed diagnostics information
- a list of all device parameters
- messages received, and
- the status of maintenance actions

The look-and-feel of all views is identical. This is due in part to the uniform symbols used for the diagnostics and for the request and maintenance status shown in the status bar.

The systematic structuring of information content produces a compact view that benefits from the hierarchical arrangement of the information. The information presented to maintenance technicians in each screen view is clearly arranged, and detailed information can be easily accessed at any time. The type of implementation described above provides maintenance technicians with full access to all plant assets and their condition so that the NAMUR recommendations on online plant asset management are satisfied in full.

When operators perform their process management tasks, they benefit from the same kind of systematic information structuring that supports maintenance technicians in ensuring the availability of production facilities.

3. CONCLUSION

The support of maintenance people by real-time information about the actual conditions of the plant components as well as of the automation equipment helps to realize new and better strategies for increasing the availability of the production.

The migration from corrective maintenance towards condition-based and predictive maintenance becomes possible and reduces the maintenance effort additionally.

A requirement analysis based upon the recommendations published by important associations of users in the field of chemical and process industry shows that the necessary basic information is already existing in the applied process control systems and that the necessary additional functions can easily be integrated in the process control system by the use of the existing mechanisms and engineering tools.

Also the needed consistent separation of the information for the process control and the maintenance task can be achieved by using standard means of a process control system like SIMATIC PCS 7.

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