How a Modern CMMS Supports to Optimize Maintenance

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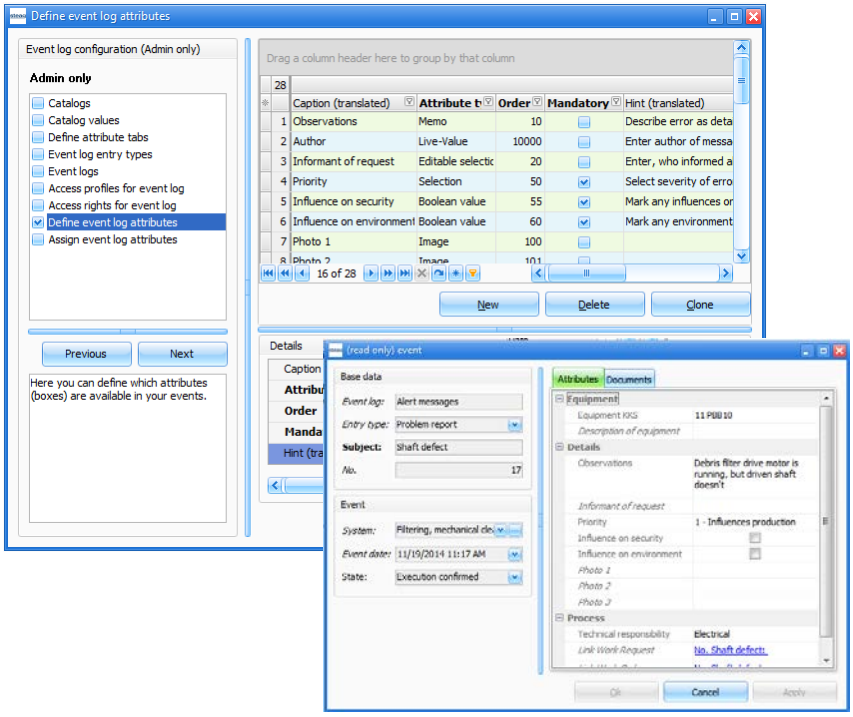

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1. Abstract

As an owner and operator for more than 10 gigawatts of installed electrical generation capacity plus several operation & maintenance contracts worldwide STEAG knows well about the requirements of the hands-on business. The technical operation of all kinds of power plants and industrial facilities can be a challenging task due to numerous environmental and health, market, quality and organizational targets.

An IT-based computerized maintenance management system (CMMS), which puts the maintenance personnel AND the asset in the center of attention, helps operators to focus on the real important tasks. Such a system should consistently support operators from the erection phase through the operation period and also provide the legal documentation. Therefore, tasks and deadlines should be easy to organize and optimize, an event log should keep track of all important incidents and an information box should actively notify the respective responsible person for a specific task. Of course, an integrated document management system and a comprehensive plant index make sure that work orders and tasks can be assigned precisely.

The paper will show how STEAG masters these challenges using its CMMS solution SI®/PAM under consideration of different given maintenance strategies. Therefore it describes and compares experiences gained with SI®/PAM in several projects ranging from power plants to wind farms.

2. Maintenance with CMMS

All kinds of power plants and industrial facilities are facing an increasingly difficult economic environment. Therefore it is becoming all the more important to ensure a high availability of plants and components at the scheduled times and thus to the greatest possible extent an undisturbed operation of plants and facilities. Cost-effective maintenance strategies contribute to this to a significant extent.

When implementing such strategies, however, the potentials of computerized maintenance management systems (CMMS) should be exploited as well because in a sense they provide the instruments to positively influence the key characteristics for describing the process efficiency of machinery and plants. With the right combination of maintenance strategy and CMMS it is to be expected that the average operating time between two failures (MTBF – mean time between failures) is extended, the average time to a repair (MTTR – mean time to repair) is reduced, and the average cost of spare parts per plant shutdown (MCRP – mean cost of replacement parts) decreases.

Condition-based maintenance has proven to be an economical alternative to a reactive or preventive maintenance in power plants. While in the case of a reactive maintenance a system part or a component is only replaced when damage has occurred, preventive maintenance intends to avoid potential damages or defects by preventively replacing parts liable to wear in particular. Both strategies have a different impact on the plant availability; also, they tie up human resources and require an appropriate stock keeping of spare parts. Condition-based maintenance, however, is oriented towards the actual condition of a system part or a component, which means that this strategy always involves a certain risk assessment regarding the probability of a failure. This risk assessment can be effected on the basis of historical data. Condition-based maintenance thus offers significant potentials for decreasing the overall cost of maintenance and repair while at the same time increasing the availability of plants and further technical installations.

The data base required for such a maintenance strategy, however, is usually also considered a disadvantage as initially it makes it necessary to log the condition of plants and components over a longer period of time. A CMMS like SI®/PAM by STEAG Energy Services (SES) not only

represents the crucial basis for this, but in addition it also allows to implement more efficient organizational processes, enables a better controlling of the maintenance procedures, and supports power plant operators in complying with the legal requirements.

3. The CMMS Solution SI®/PAM

The system SI®/PAM developed by STEAG Energy Services is an IT-based operation and maintenance management system that is adjustable in a highly flexible way and can be applied in many industries. The modular concept and the well-designed user interface provide the user with the flexibility required for adjusting the system to various and sometimes highly individual tasks.

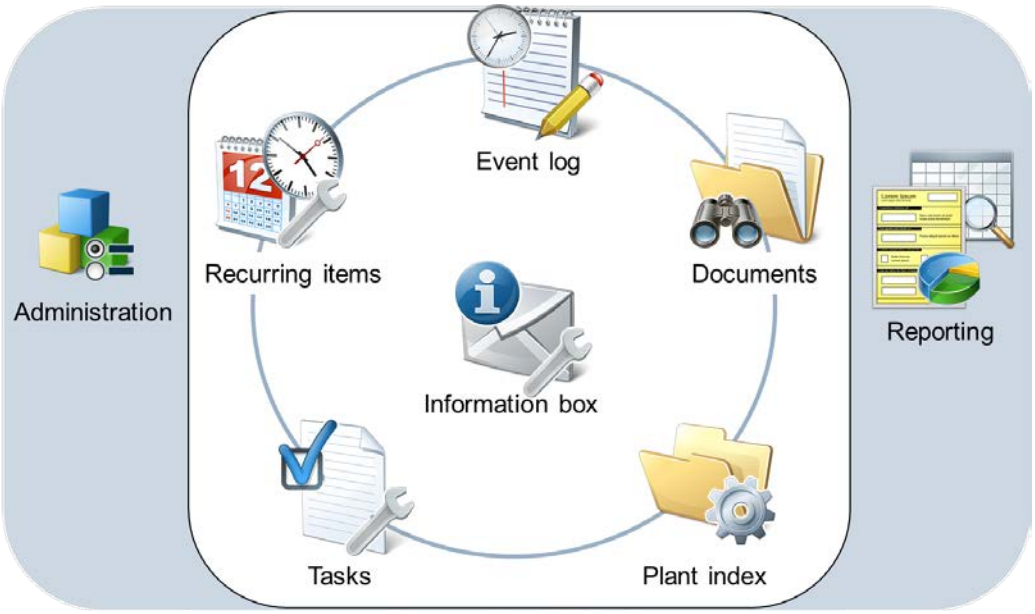

Fig. 1: Overview of the modular structure of SI®/PAM

A basic prerequisite for using a SI®/PAM as a CMMS is the setup of the master data. Among those are the plant index (see Fig. 2), the index of existing components (operating inventory), and the component type index for the well-arranged administration of the technical data and the standard maintenance schedules. Here existing standards like e.g. KKS, RDS-PP as well as plant data according to VGB Guideline R171 can be used. On this basis, the lifetime of the component and the plant history emerge in the course of the service life of the CMMS and the lifetime of the plant. In addition, a register of persons with an information box is required that provides information on supervisors, staff members, as well as their deputies. This list is the basis for controlling the responsibilities and distributing information.

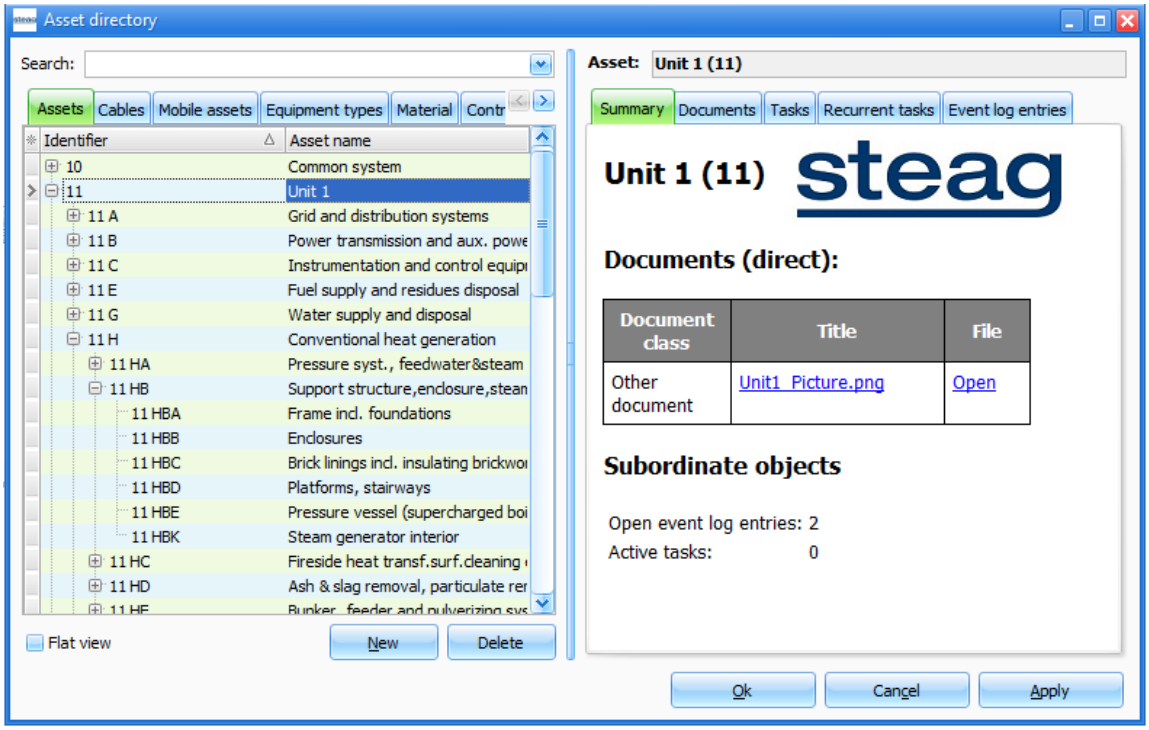

Fig. 2: Hierarchical structure of a plant index with the corresponding technical data as attributes.

Two essential concepts of SI®/PAM as a CMMS are also the roles and their allocations as well as the central distribution of information. By means of roles and role allocations, standardized information paths and task allocations can be used flexibly. Here the role allocations map the responsibilities, the internal policies, and the information paths of a power plant operation. In practice, the CMMS identifies with help of the role allocations the respectively defined responsible and executing persons depending on the affected system part, the component type, and the type of activity to be executed.

The distribution of information to the persons in question can be effected via a kind of electronic “mailbox” integrated in the CMMS, which provides the respective user with precisely the tasks intended for him. This “information center” automatically determines the recipients of information and tasks according to rules stored beforehand.

The CMMS solution SI®/PAM also covers required features like *document management, reporting and administration.*

The basic module *tasks* of SI®/PAM represents all jobs to be executed regularly as recurring items. Legally required activities in particular can be monitored and documented this way. All unpredicted events and information that require logging are saved in the module *event log* (see Fig. 3). Any number of “event logs” can be created at will. The module can be used by various groups of persons e.g. for logs, shift logs, damage reports, etc. All relevant documents regarding tasks and events, plants or components can be stored within the module *documents*. Alternatively, documents stored outside of SI®/PAM can be linked with the document management module. Documents can be added to each object; multiple linking of documents to different object types is possible as well.

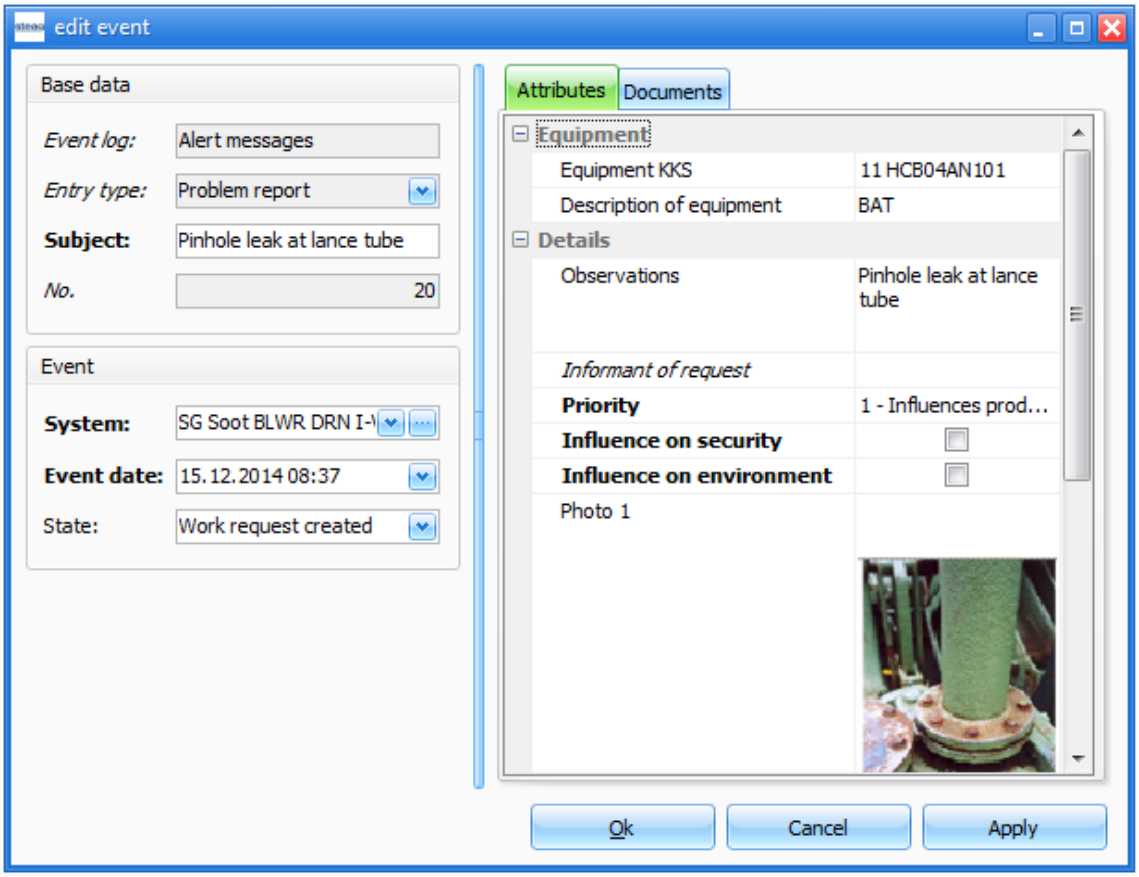

Fig. 3: Editing an event within the module event log of SI®/PAM

4. Implementation of a CMMS

In what follows, the implementation of a CMMS is described as an example on the basis of several phases. The first step consists in collecting the basic data; for this, at least the following conditions have to be met:

- Collecting the data of the future users and their interrelations in the information box
- Registering the technical plants (if applicable, by importing from other file formats) in a hierarchical structure

If the CMMS is to be implemented with the objective of an organized technical documentation of the plant, it is advisable at least to add the component type index with the technical data as well as the list of existing components or to import them from an existing file, in addition to the plant index and the personal data.

4.1 First applications

In Phase 2, first applications of the CMMS can be implemented based on the responsibilities. For this, a system has to be able to map the in-house regulations concerning the responsibility for the budget and the execution of work. The concept of the allocations described above considers the fact that mostly it is known from the outset who will execute which tasks. Such in-house rules can therefore be stored in the system once and can then be used again and again. This procedure and functionality respectively proves to be very efficient e.g. when a damage is to be reported concerning a certain component or when a specific maintenance task is to be executed.

4.2 Maintenance scheduling

Phase 3 of the implementation is dedicated to maintenance scheduling. For regular reminding of scheduled maintenance measures, enough basic data – the plant index, the personal data, and the rules for the responsibility of work – are already available in the CMMS to schedule recurrent measures and automatically inform the correct users of their due dates. If a lot of components of the same type exist and the maintenance work to be executed is to be planned in somewhat greater detail, it will make sense to compile an “index of component types” first. Besides technical data sheets, it is possible to create standard maintenance schedules for a component type, which are then available for all operating sites of this component. During the allocation of a component type to a component of the plant index, new entries emerge in the index of the existing components. Hereby, the inventory list of the company is created in parallel.

4.3 Order to the “document jungle“

Phase 4 deals with the documentation of plants and components. Previously, without IT-based planning and control of maintenance, this was widely scattered in most cases. Regarding document management, a CMMS should support the storage and administration of any kind of documents as well as their allocation to component types, elements of the plant index, entries in the event log, maintenance measures, etc. using a specific system of keys. A document can thus be marked and linked to the objects of maintenance by means of the document key and additional attributes (meta data). The document registered this way can be accessed via all workstations equipped with the CMMS.

4.4 Preconfigured keys

For practical purposes, a document key in such a system should already indicate the nature of the document: an instruction manual, a piping diagram, a data sheet for an object of the plant index, a CAD sectional view of a certain component type, the text of a legal requirement, or a scanned letter of approval, to name just a few examples. Standard software is used for editing and displaying the documents managed this way. Often key systems are already in use for labeling plants and components. Therefore, besides the system parts (plant index, from a procedural point of view), the CMMS should allow to manage a number of other designations by means of keys.

4.5 System requirements and possible environments

Basically, nothing more than a server with a database application as well as the actual software for the planning and control of the maintenance is required for implementing a CMMS solution. The popular as well as tried and tested network protocol TCP/IP lends itself as the communication interface between the program and the server. Although a CMMS can be run and used as a stand-alone software application, there are more frequent requests to integrate such a system into an environment of other data processing applications.

5. New potentials owing to smartphones and tablet PCs

Owing to the rapid development of smartphones and tablet PCs as well as their increasing in-plant use, further promising potentials for mobile maintenance are arising. In contrast to PDAs, appropriate apps allow to use a significantly larger range of functions of the central CMMS on such devices. The user-specific configuration previously made on a server is thus available to its full extent during the mobile maintenance as well. Besides the comfortable handling typical of smartphones and tablet PCs, such devices offer significantly more memory compared to PDAs. Considerably more data can therefore be used and edited “offline“, i.e. without a connection to a server, in the context of on-site measures on plants and components. The only prerequisite for this is the transfer of the required data from the central CMMS to the mobile device via wireless LAN or USB interface. In addition it is always possible to use a 3G or 4G cell phone connection in the context of the mobile maintenance operation, so that the data as well as messages entered in the app can immediately be transferred to the central CMMS. Besides the saving of time when long distances in power plants with widely scattered facilities need not be covered, this procedure also ensures – among other things – a high degree of data consistency between the central CMMS and all the devices used in the mobile maintenance. The central maintenance where the backend of the CMMS is located can thus process the information from the field considerably faster and more specifically when required.

6. Example – Implementation of the CMMS solution SI®/PAM

Utility companies are facing increasing market requirements. Therefore the operating procedures have to be designed to be as efficient as possible, in particular regarding the operation of technical installations. In most cases, the resulting requirements to an efficient maintenance including documentation can only be fulfilled by means of an IT-supported solution.

As regional utility companies attach particular importance to a sustainable energy generation in order to offer the right balance between sustainability, security of supply, and economic efficiency, the decision for the implementation of a renewable-energy power plant has been taken. This represents the context of a recent project: a new biomass CHP plant in Oberhausen (see Fig. 4). The construction of the biomass CHP plant started in January 2012, and only 13 months later, in February 2013, the plant went online.

Fig. 4: Biomass CHP plant in Oberhausen

Since as early as 2005, the utility company has been using the SI® system by STEAG Energy Services GmbH (SES) for the IT-supported maintenance of technical installations. Therefore they also decided for a co-operation with SES in the new project.

The specific requirements to SI®/PAM consisted in the near-term introduction of the modules *plant index* and *event log*. As the next step, the module *tasks* should be implemented for entering recurring items for maintenance and repair of the biomass CHP plant, along with the module *document management.*

Within this project a plant index according to KKS (a standardized classification system for power plants) was created for the operation of the biomass CHP plant. As desired by the customer, a representation as well as encryption up to equipment unit level was chosen (Fig. 5). The individual levels were to be selected after the field trial. Instead of component types, equipment unit classes were set up and furnished with special attributes. Data were imported into the plant index based on lists with technical data in table form provided to some extent by the plant suppliers. Here the configuration of the technical characteristics using the supplier data at the KKS level “Equipment unit” was simplified in particular because SI®/PAM permits a flexible representation of the available data. Moreover, the intelligent import interface of the software detected inconsistencies in the data, so that the system could be used only one week after provision of the data.

Already during the commissioning and in trial operation, the specific project required a shift log with several message types for recording faults, shift changes, and other information. Thus for documenting the trial operation, the different message types were set up in an *event log*. For the trial operation of the biomass CHP plant, the configuration of the module was also supplemented with additional data fields for selecting the most frequent causes of faults and the resulting downtimes. In this context, SES was able to fulfill the request for an evaluation of the message types with little effort.

Fig. 5: The individual equipment units of the plant are recorded in the plant index

The experiences with SI®/PAM have been positive throughout, because all requirements of the specific project were implemented quickly, among them the uncomplicated and flexible adjustment of the fault documentation with recording of downtimes to the particular situation of the trial operation of a biomass CHP plant with the appropriate reporting. In this context, the customer particularly emphasizes the fast commissioning of the system by importing the KKS lists, the option to supplement shift log with photos, and the form-like input of shift changes with predefined value sets and learning input fields. Also the various logs – biomass CHP plant, plant log for the staff on site, and shift changes – can be designed freely. From this point of view, the use of SI®/PAM thus offers immediate added value for the claim management.

6.1 Practical Experiences with the CMMS solution SI®/PAM

The module *event log* was supplemented with further shift logs and message types e.g. to replace the paper-based reading of some operating parameters. The freely configurable reporting module of SI®/PAM made the evaluation based on Excel lists redundant. The previous input effort was no longer required.

The customer also supplemented the plant index several times with additional data considering the data base recorded so far. Owing to the intelligent import interface of the system, this was affected flawlessly.

Finally, the function *recurring items* was put into operation with the module *tasks* to be able to coordinate both maintenance measures and inspections by the authorities in a single system. Here SI®/PAM allows to control the responsibilities and processes entirely according to the operational necessities; the function *information box* informs about the currently pending tasks.

As a document management system (DMS) was already in use, the *module document management* in SI®/PAM has only been used for linking the documents stored in the DMS with

the plant index in SI®/PAM so far. This way, a double data administration is avoided and at the same time a more transparent information platform for all relevant plant data is achieved.

By now the customer is using the system for further, unforeseen tasks like e.g. for fault tracking or for managing IT requirements. The utility company has implemented these tasks in SI®/PAM autonomously, which is possible owing to the intuitive operability of the software solution.

As a next step, the introduction of the SI®/PAM module for the mobile processing of tasks is in progress, which allows the confirmation and documentation of tasks on a tablet or smartphone, identifying the respective installations easily and safely via RFID and barcodes.

7. Conclusion and Outlook

Regular maintenance and repair measures reduce the vulnerability of machinery and plants to failures, increase their availability, and therefore significantly contribute to the productivity and thus to the added value of a company.

However, often maintenance still involves a lot of paperwork, e.g. work orders, logs or even file cards. If an IT-based maintenance is applied at all, often a classical “multi-tool strategy” with software like Excel, Access and Outlook is used. Thus the most various data is located at the most diverse places and is therefore neither accessible for everyone nor easy to find. In addition, there is an inconsistency of data that not only impedes the logical connection of the data but also leads to a decentralized, complex data administration. All that is neither efficient nor economical. Furthermore, regular problems are to be expected with changing versions of the mentioned office applications.

A solution to that are the so-called computerized maintenance management systems, or CMMS. Such systems enable a better controlling of the maintenance procedures and support power plant operators in complying with legal requirements.

The modular CMMS SI®/PAM is a lean maintenance and operation management system with a large variety of functions, consisting of particular modules that can cover individual tasks in various plants. In the context of widely scattered facilities, SI®/PAM as a central CMMS can also be used with a mobile solution for on-site measures at machinery and plants. The system is flexible and therefore also suitable for manufacturing companies, plant engineering and construction, facility management, and generally for big companies with large production areas or widely scattered facilities.

This shows that the use of CMMS such as SI®/PAM enables plant operators to improve and simplify operation and maintenance processes for all parties involved.

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