Yokogawa helps customers make decisions smoothly

■ Providing ROI benchmark data for alarm-reducing solutions

The law, “direct and indirect losses suffered by companies as the result of neglecting the removal of defects from products are greater than the profits they receive as the result of improving product performance”, has now become widely known due to the spread of Six Sigma, a US-born improvement philosophy.

This law also holds very true for the problem of alarm flooding. This is because the oversight of important alarms or mistaken operation arising from alarm flooding may cause direct losses, such as a plant shutdown, damage of assets, a fire, fatal accidents, and/or environmental damage. These direct losses may be accompanied by indirect losses, such as the loss of sales opportunities, compensation for damages, loss of confidence in the company by society, and/or declines in the price of stocks. Thus, such oversight or mistaken operation poses the risk of inflicting enormous damage upon the company as a consequence. As an actual example, oversight of important alarms took place in a certain oil refinery due to alarm flooding that lasted as long as five hours. This oversight resulted in plant damage worth approximately 86 million U.S dollar and production losses as well.

In order to help customers once again recognize the importance of alarm reduction, Yokogawa provides benchmark data for estimating return of investment (ROI) when they have introduced alarm-reducing solutions according to the loss that they may be able to avoid by reducing alarms.

Fig. 1. Example of Plant Hazards

■ Making proposals to customers’ zone of management

Actions for improvement against alarm flooding that may inflict enormous damage upon companies is insurance for safety, and this has a direct link with society’s confidence in the company. The key to successful actions, therefore, is deciding to perform the actions in a top-down manner, securing required budgets and engineering man-hours, and carrying out the actions under the leadership of staff members well-versed in plant operation. Yokogawa is prepared to offer the optimum, practical proposals for customers’ zone of management.

■ The goal: Safe and more stable plant

As long as the design, selection and tuning of plant components (plant equipment, field instrumentation, control systems, etc.) and operation are optimum, the plant is always stable in both the steady and nonsteady states of operation and no alarms will be raised except in the event of unexpected accidents. In other words, if alarm flooding is a routine phenomenon, there must be faults to be remedied in some of the building blocks. The essence of improvement against alarm flooding is to eliminate faults in the constituent factors of plant operation that are sources of alarms, thereby realizing safe, stable plants that generate no more alarms than necessary. As the plant becomes increasingly stable, we can have better expectations for improvements in operating performance.

Yokogawa provides practical solutions based on its rich project experience

■ Performing improvements based on the Six Sigma DMAIC method

Yokogawa implements actions for improvement in accordance with the DMAIC cycle of Six Sigma, an established method for eliminating defects. The DMAIC cycle consists of five steps — Define, Measure, Analyze, Improve and Control. By sequentially cycling through these steps, it is possible to reliably carry out sustainable improvement actions. Needless to say, Yokogawa participates in this improvement program as an advisor. Moreover, Yokogawa provides a service in which it offers engineering services and package software as necessary, based on its rich project experience, in order to reduce customers' total cost of ownership (TCO) for improvement actions.

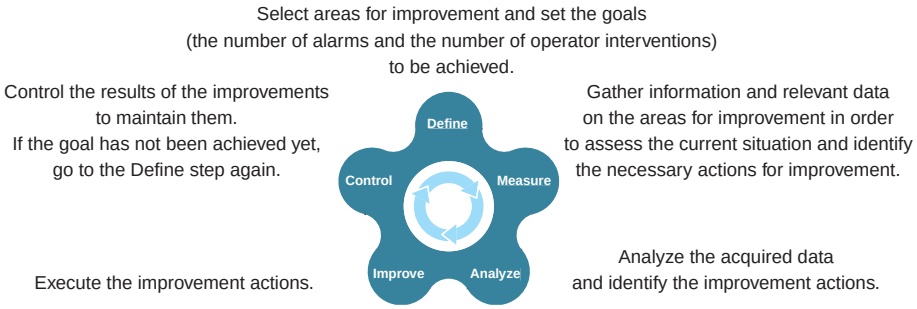


Fig. 2. DMAIC Cycle of Six Sigma

■ Setting goals in the Define step

In the Define step, the starting point of actions for improvement, the area of a plant for improvement is selected. Next, alarm-related targets by referring to the benchmarks shown below are set. The targets should be previously normalized so that they can easily be compared between plants of different scales/types. In the case of plants where operator intervention takes place routinely, such intervention can be the cause of alarm flooding. Yokogawa suggests including the frequency of such intervention in the factors to be reduced.

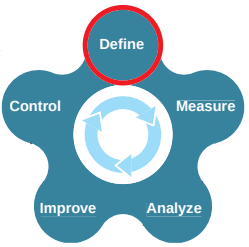


Table 1. Examples of Target Benchmarks

Target level	Target variables	Typical benchmark in Europe	Typical benchmark in Japan
Manageable	Frequency of alarms	One alarm in 5 min per operator	One alarm in 2 hrs per 100 input points
	Frequency of operator interventions	-	One intervention in 10 min per 100 control loops
Desirable	Frequency of alarms	Less than one alarm in 10 min per operator	Less than one alarm in 4 hrs per 100 input points
	Frequency of operator interventions	-	Less than one intervention 1 hr per 100 control loops

■ Acquiring data in the Measure step

In the Measure step, we confirm the current frequency of alarms and operator action. In addition, we acquire and store relevant data to identify the cause of such alarms and determine improvement actions. Yokogawa provides data-specific solutions for each type of relevant data.

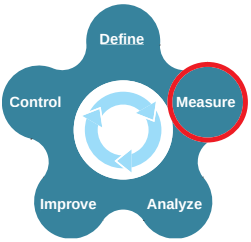


Table 2. Yokogawa's Solutions for the Measure Step

Data Type	Solutions	Functions
Control system events	Exaplog™ (Event analysis package)	Data collection, archiving, display, analysis, reporting
Process data	Exaquantum™ (Plant information management system)	
Field instrument events	PRM (Plant resource manager)	

The Exaplog event analysis package acquires event messages, including alarms and operator interventions, at fixed periodic intervals from a control system and archives them. In addition, the package can analyze the archived data in an interactive manner, as well as calculate and report the typical performance indicators (total numbers of alarms in a given period, most frequent alarms in a given period, repeating alarms, longstanding alarms, etc.) mentioned in EEMUA (Engineering Equipment and Materials Users Association) Publication No. 191. Thus, the package can also be used in the Analyze step that follows.

Fig. 3. Exaplog Analysis Windows

After measuring the current frequency of alarms and operator interventions, we plot them on a comparative graph, along with the numerical targets. This strategy is extremely effective for checking the validity of the goals set in the Define step and for identifying the trends in each plant requiring improvement.

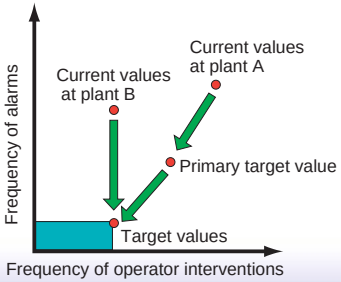
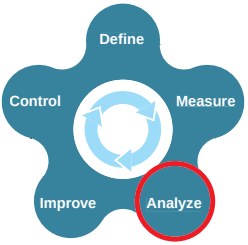


Fig. 4. Mapping Target Values and Current Values

■ Identifying the causes and defining improvement actions in the Analyze step



In the Analyze step, we identify the cause of alarms and work out improvement actions for alarms that can be reduced, according to the analysis results and reports obtained using the solutions for the Measure step and through discussion with the workplaces and departments concerned.
The improvement measures serve two purposes:

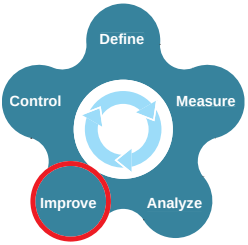
- **immediate improvement in which the system's functions are used to prevent unnecessary alarms from being repeatedly generated**
- **fundamental improvement in which the cause itself of alarms being triggered is reexamined**

We decide which type of improvement measures to take, taking into account the ROI and the difficulty of improvement.

Table 3. Cause of Alarms That Can be Reduced, and Improvement Actions

Problem areas and root causes	Practical and immediate solutions	Fundamental re-engineering solutions
1. Field Instrumentations and machineries		
Device malfunctions,unsuitable control valve,suboptimal range setting	Alarm repetition suppression **(AAASuite™)**	Maintenance, modification, or replacement (consultation)
Machinery malfunctions,insufficient capacity,insufficient capability		
2. Alarm settings and controllability		
Unnecessary alarms	-	Alarm setting elimination (engineering)
Suboptimal alarm settings	-	Static alarm suppression **(AAASuite)** Dynamic alarm optimization **(AAASuite)**
Suboptimal PID tuning	Alarm repetition suppression **(AAASuite)**	PID control loop retuning **(MD^{Pro})**
Suboptimal control sequence		Sequence modification (engineering)
Insufficient controllability		APC implementation **(Exasmoc™)**
3. Operator skills		
Incorrect operation/procedure	-	Operation navigation **(Exapilot™)**
4. Production process design		
Clogging, Adhesion,Composition fluctuations,Unstable reactions	-	Maintenance or modification (Consultation)

■ Carrying out improvement actions in the Improve step



In the Improve step, we carry out improvements according to the solutions we determined in the Analyze step. Here, we introduce typical improvement actions.

• Automatic alarm repetition suppression: AAASuite

AAASuite is a package of functions related to alarm management. This package gives the operator only the truly necessary alarms at the optimal timing. AAASuite consists mainly of functions effective for reducing alarms and advanced alert functions for supporting the enhancement of the operator's individual performance. Of these functions, the function to automatically prevent the repetition of unnecessary alarms is especially effective for cases when the causes of alarms are equipment-based constraints or faulty process designs and the drastic improvement of the problems would require significant expense and man-hours. Thus, this function is a more practical solution than others.

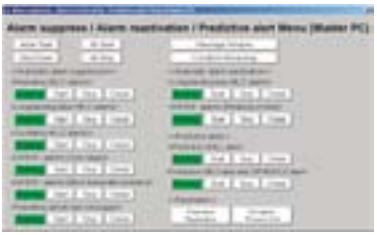


Fig. 5. AAASuite Operation Window

Table 4. Typical Unnecessary Alarms Automatically Suppressed by AAASuite

Type of alarm	Root cause of alarm occurrence
Repeating HI Repeating LO	High-frequency fluctuations on a process variable, noise on a process variable,repeated action of on-off control loops, device malfunction,suboptimal alarm threshold settings
Longstanding HI Longstanding LO	Suboptimal alarm hysteresis setting
Chattering HI-LO	Suboptimal PID parameter settings
Repeating IOP Repeating IOP-	Over range, devices having intermittent problems
Repeating Annunciator	Improper sequence program

HI: high limit alarm, LO: low limit alarm, IOP: upper input open alarm, IOP-: lower input open alarm

• PID control loop retuning: MD*pro*

MD*pro* is a package used to systematically measure and monitor the performance of PID control loops. This package is responsible for measuring the controllability of control loops, the ratio of controller in service, the ratio of closed loops, and compliance ratio, and for making incentive calculations. MD*pro* outputs the measurement and calculation results in report forms by e-mail.

• Advanced process control: Exasmoc

Exasmoc is a multivariable model prediction control package built on the technology developed by Shell Global Solutions International B.V., the technology center of the major oil company, Shell. This package simultaneously meets both optimum and economical plant operation by correlating multiple variables with one another using factors such as conditions of constraint and economic efficiency. By forming a business partnership with Shell Global Solutions International B.V., Yokogawa is exclusively offering this package worldwide.

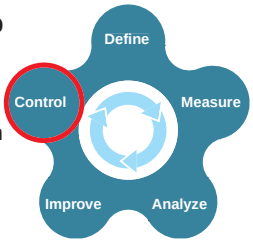
• Operation navigation: Exapilot

With the Exapilot package, it is possible to define the best operating procedures applicable to nonsteady-state operation or troubleshooting in a familiar flowchart format, according to the existing standard operating procedures (SOP) and the operating expertise of skilled oaperators.
During system operation, the flowchart changes its color according to the progress of plant operation, providing visual navigation for the operator. In addition, the board operator's monitoring and interventions can be automated. For tasks that cannot be automated due to constraints imposed by field manual instruments, the package gives confirmation messages to be passed on by the operator to prompt the person in charge to take action. This feature is effective for preventing the operator's oversight of tasks or mistaken operation.

Fig. 6. Exapilot Operation Window

■ Evaluating the improvement results in the Control step

In the Control step, we implement control in order to evaluate and maintain the results of improvements. The Exaplog event analysis package used in the Measure step is also useful for evaluating and controlling the improvement results. If the preset goals have not yet been achieved, we go into the next DMAIC cycle.



■ Analyzing the state of alarm flooding by using a simple analysis service

In this booklet, we have introduced Yokogawa's alarm-reducing solutions. After reading through this booklet, you may have questions such as "How frequently are alarms generated in our plant?" or "What is responsible for the alarm flooding in our plant?" If you are interested in alarm reduction, please feel free to consult Yokogawa. We are ready with a wide range of solutions which can be tailored to your needs, from a one-day simple analysis service, to a full-fledged consultation for improvement by forming a project team.

■ Contact Us

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