

# VigilantPlant Services to be a Customers' Lifetime Partner for Operational Improvements

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*Since its foundation in 1915, Yokogawa Electric Corporation has developed many innovative and high-quality industrial automation (IA) systems and products as an instrumentation and measurement supplier, using technologies in the areas of measurement, control, and information, and has been supplying them to the global market. Yokogawa has accumulated a wealth of service experience and expertise through the selection, implementation, expansion, modification, and maintenance of IA systems and products, which are invaluable for customers' operational improvements. Recently, Yokogawa has launched a new comprehensive suite of services, VigilantPlant Services, to be a customers' lifetime partner for operational improvements, providing IA systems and products combined with in-depth know-how. This paper introduces the features and specific services of VigilantPlant Services.*

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## INTRODUCTION

Due to emerging competitors from the rapidly growing countries such as India and China and the global economic downturn triggered by the Lehman shock, many companies in the process industries are struggling to survive the severe global competition. Aiming to achieve ideal plant operation, continuous operational improvements have been carried out day after day in production sites around the world.

Since its foundation in 1915, Yokogawa Electric Corporation has been supplying the process industries with many innovative and high-quality industrial automation (IA) systems and products, focusing on technologies in the areas of measurement, control, and information. These are key infrastructure components for achieving customers' ideal plant operation that can secure safety, optimize production, maximize the use of plant assets, and optimize the total cost of ownership (TCO). Therefore, these systems and products must be properly selected, introduced, operated, and maintained.

Such tasks were usually performed by customers themselves with sufficient human resources and extensive experience. These days, however, customers are facing difficulties carrying out these tasks by themselves due to the shortage of human resources and expertise caused by the

retirement of skilled engineers, rapid advancement and multi-functionalization of IA systems and products, and the trend toward a quick return on investment. As a result, they expect Yokogawa to complete such tasks relying on its wide variety of experience of project accomplishments and after-services. In response to this expectation, Yokogawa has launched a comprehensive suite of services "VigilantPlant Services" with its strong commitment to serve customers as a lifetime partner for continuous operational improvements.

This paper introduces the IA business environment, changes in customer needs, and features of the new VigilantPlant Services and its service product portfolio responding to those needs. It also outlines Yokogawa's existing IA systems and products that are used as a platform for VigilantPlant Services.

## BACKGROUND OF DEVELOPMENT OF VIGILANTPLANT SERVICES

In response to current trends in the process industries and customers' latest needs for outsourcing operational improvement activities, Yokogawa has planned and developed VigilantPlant Services.

### Shortage of Human Resources and Expertise for Operational Improvements

The anticipated demographic challenges as skilled engineers and operators retire at production sites are surfacing in developed countries such as Japan and the U.S.

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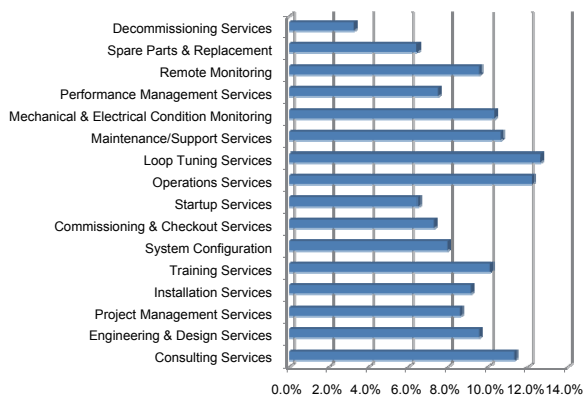
At the same time, increasing demands for such expertise in emerging countries such as China and India are intensifying the challenge. The process industries today focus more on the R&D and marketing of competitive products and sales activities, resulting in the lack of sufficient personnel to improve plant operation. In addition, the shrinking young workforce and less interest in engineering as a career today make the situation more difficult for customers to carry out their plant operational improvements by themselves.

**Rapid advancement and multi-functionalization of IA systems and products**

The advancement and diversification of customers' needs to cope with the increasing global competition and rapid progress in electric and information technology supported by the standardization of operating systems (OS) and communication interfaces have led to the rapid advancement and multi-functionalization of IA systems and products since the late 1990s. To make the best use of such complex IA systems and products, detailed knowledge and expertise of them are required.

**Quick Return on Investment**

As shown in Figure 1, there is growing interest in operating and consulting services for existing IA systems and products in plants as an area to achieve a quick return on investment<sup>(1)</sup>.



**Figure 1** Growth rate in IA services

**Transforming to a Lifetime Partner for Operational Improvements**

In these circumstances, Yokogawa has developed VigilantPlant Services with a strong commitment to becoming a lifetime partner of customers for operational improvements by offering them a wealth of expertise in improving operations by fully utilizing IA systems and products which Yokogawa has acquired through the accomplishment of projects around the world. It is the supplier's responsibility to offer customers such expertise to help them use Yokogawa's IA systems and products throughout the plant lifecycle.

**OUTLINE OF THE VIGILANTPLANT FOR IDEAL PLANT OPERATION**

In 2005, Yokogawa announced the 'VigilantPlant' vision as the ideal plant, the concept of which is shared between the customer and Yokogawa<sup>(2), (3)</sup>. VigilantPlant Services according to this vision is a comprehensive brand of a suite of services to assist customers to achieve a VigilantPlant.

**VigilantPlant**

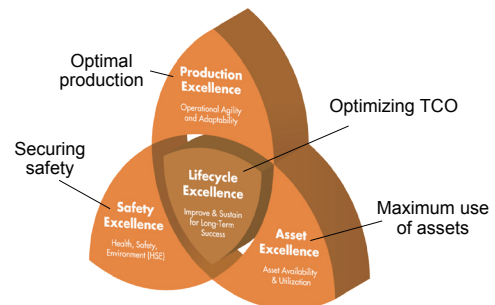
VigilantPlant is an ideal plant operational concept shared between the customer and Yokogawa. More specifically, VigilantPlant is a plant in which:

- All the necessary information is given to all plant operators.
- Operators are able to quickly react to changes in the external environment while production activities run without interruption.
- Both equipment and people are able to continue to evolve for the future.

As a result, fully optimized operation which can quickly adapt to future changes is achieved.

**Customers' Competitive Edge by Achieving VigilantPlant**

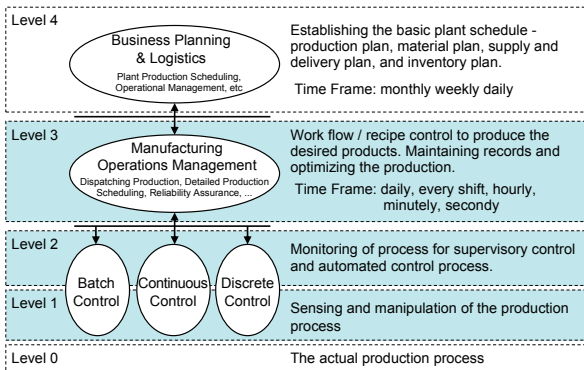
Figure 2 shows the Operational Excellence Model for plant operation. The model represents the four competitive edges (excellences) i.e. customers' benefits, which they can obtain by achieving VigilantPlant.



**Figure 2** Operational Excellence Model

- **Securing safety (Safety Excellence)**  
Independent Protection Layers referred to in ANSI/ISA 84.00.01 (IEC 61511) is a concept designed to prevent a plant disaster and its consequences<sup>(4)</sup>. VigilantPlant ensures plant safety by verifying, improving and maintaining the protection functions in the 2nd to 4th layers of the Independent Protection Layers described in Table 1 to ensure they are working effectively throughout the plant lifecycle.
- **Optimal production (Production Excellence)**  
The functional enterprise-control model defined in ISA-95 (IEC 62264) is a hierarchical model of enterprise functions to optimize production<sup>(5)</sup>. VigilantPlant ensures that the production of plants is optimized by verifying, improving

and maintaining the production control functions in the 1st to 3rd levels described in Figure 3 to ensure they are working effectively throughout the plant lifecycle.

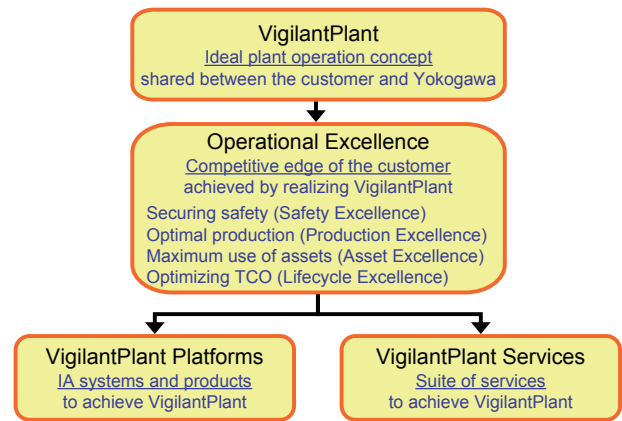


**Figure 3** The area of the ISA-95 (IEC 62264) functional hierarchy covered by VigilantPlant

- **Maximum use of plant assets (Asset Excellence)**  
 VigilantPlant ensures the maximum utilization of plant assets throughout the plant lifecycle by optimizing the maintenance timing of assets, including field instruments such as transmitters and control valves, and process equipment such as heat exchangers and cracking furnaces.
- **Optimizing TCO (Lifecycle Excellence)**  
 VigilantPlant ensures that the Total Cost of Ownership (TCO) of IA systems and products is minimized by maintaining and improving the reliability, availability, serviceability, integrity, and security (RASIS) at the proper levels throughout the plant lifecycle.

**VIGILANTPLANT SERVICES FOR ACHIEVING VIGILANTPLANT**

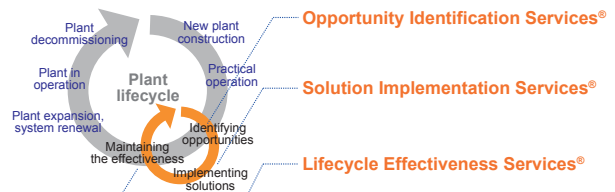
Figure 4 shows the concept of VigilantPlant Services. To help customers achieve ideal plant operation (VigilantPlant) and obtain a competitive edge in plant operation (Operational Excellence), Yokogawa provides various IA systems and products (VigilantPlant Platforms) and a suite of services (VigilantPlant Services).



**Figure 4** VigilantPlant Services concept

**Product Lineup of VigilantPlant Services**

As shown in Figure 5, VigilantPlant Services consist of three types of Services corresponding to customers' progress in operational improvement activities. Customers can introduce any Services depending on their progress. In line with the release of VigilantPlant Services, many services have been newly developed, especially for the Opportunity Identification Services and Solution Implementation Services.



**Figure 5** Three Types of VigilantPlant Services

Figure 6 shows the portfolio of VigilantPlant Services. The three types of Services are circularly linked to each other to help customers achieve continuous operational improvements. For example, a customer introduced the PID Loop Controllability Improvement, one of the services of the Solution Implementation Services, and achieved improved

**Table 1** Independent Protection Layers covered by VigilantPlant

Layer	Title	Specific Examples
1st layer	Process Design	Process design for achieving an inherently safer plant. This includes investigation of lowering the operating temperature and pressure or minimizing the amount of hazardous materials to achieve the same process.
2nd layer	Basic Process Control System (BPCS)	The systems, including distributed control systems (DCS), mainly intended for monitoring normal plant operation. These systems activate alarms when process values exceed set thresholds and operator intervention is required.
3rd layer	Critical alarms differentiated from those activated by BPCS	Applied when there is enough time for the operator to intervene.
4th layer	Automatic Safety Instrumented System / Emergency Shutdown System	Shutting down plants automatically and safely with a safety interlock system or emergency shutdown system, etc.
5th layer	Physical Protection (Relief Devices)	Pressure relief systems such as safety valves and rupture disks.
6th layer	Physical Protection (Dikes)	Dikes for localizing spilled fluid.
7th layer	Plant Emergency Response	Emergency plans for plant safety.
8th layer	Community Emergency Response	Emergency response plans for communities or public facilities.

controllability. After a while, if the Regular Effectiveness Analysis, one of the services of the Lifecycle Effectiveness Services, reveals some deterioration in control performance caused by a change of raw material, Yokogawa would propose re-introducing the PID Loop Controllability Improvement to restore the control performance.

To offer customers around the world high-quality services, Yokogawa has an in-house qualification system for service engineers who offer services. Those who have received a wide range of training and passed the examination can provide services.

**Opportunity Identification Services**

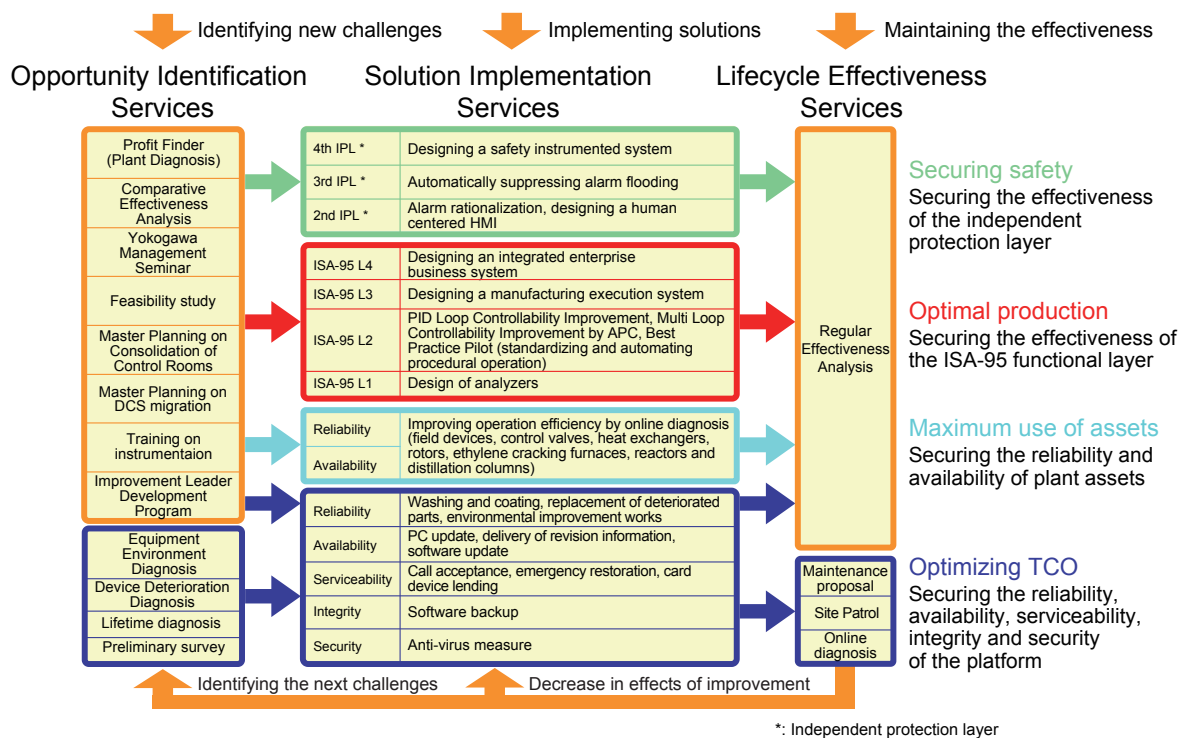
Opportunity Identification Services support the provisional step for operational improvement such as identifying new improvement opportunities, selecting an effective solution, creating an improvement plan, and training the persons in charge of improvement. Phased approaches are provided considering the customer's progress in opportunity identification activities. The typical services are as follows.

- Comparative Effectiveness Analysis  
Comparative Effectiveness Analysis assists the identification of new improvement opportunities through the comparison of effectiveness indexes, which show how effectively existing IA systems and products are being used in plant operation. Using those indexes, the customer can compare his operational performance with those in the past, those from the customer's other plants, and those of competitors' plants.

- Yokogawa Management Seminar  
Yokogawa Management Seminar is a brainstorming seminar where top management from customers gather with those from Yokogawa to discuss how to solve plant operation issues such as human resources, organization, budget or motivation to improve the situation. This service supports customers' decision-making and future planning.
- Master Planning  
Master Planning creates a master plan for solving the identified improvement opportunities. This service includes investment planning and recovery planning. This service mainly supports the introduction and migration of a control system, and consolidation of control rooms.
- Improvement Leader Development Program  
Improvement Leader Development Program provides practical training for next-generation improvement leaders. The participants can experience various improvement activities on a virtual plant configured using a dynamic process simulator, and efficiently learn about improvement methodologies, related laws, regulations and guidelines, and utilization of tools.

**Solution Implementation Services**

Solution Implementation Services supports customers in solving problems by offering the best practice for their identified opportunities. As shown in Table 2, all services in Solution Implementation Services are standardized in accordance with the Six Sigma DMAIC steps, which are a famous product quality control and management control



**Figure 6** VigilantPlant Services Product Portfolio

method, to carry the improvement activities within a specified period without missing steps.

**Table 2** Procedure of Solution Implementation Services

Step	Task
Define	Set the improvement goal
Measure	Gather relevant information for improvement
Analyze	Analyze the information and derive the solution
Improve	Implement the solution
Control	Evaluate the improvement result

The main services to achieve each excellence of operations are described below.

- Services for securing safety (Safety Excellence)
  - Alarm Rationalization
  - PID Loop Controllability Improvement
  - Control Room Design
- Services for maximum use of assets (Asset Excellence)
  - Field Digital Device Diagnostics
  - Control Valve and Control Loop Diagnostics
  - Asset Performance Diagnostics

These three services are collectively called the InsightSuiteAE plant asset effectiveness optimization services (AE: Asset Excellence).

- Services for optimal production (Production Excellence)
  - Best Practice Pilot (standardizing and automating procedural operation)
  - PID Loop Controllability Improvement
  - Multi Loop Controllability Improvement by APC (Advanced Process Control)
    - Multivariable model predictive control
    - Blending control

The followings are industry-specific services.

- Control Parameter Optimization Service for Paper Machine Quality Control Systems
- BTG (Boiler, Turbine, Generator) Optimizing Control Service
- Refinery Operation Modernization Service

- Services for optimizing TCO (Lifecycle Excellence)  
Services based on RASIS indexes described in Table 3 .

**Table 3** Solution Implementation Services based on RASIS indexes for optimizing TCO

Category	Services
Reliability	Washing and coating Replacement of deteriorated parts
Availability	PC upgrade System migration
Serviceability	Emergency restoration Card device lending
Integrity	Software backup
Security	Anti-virus measure

As an example of the Six Sigma DMAIC procedure of the Solution Implementation Services, Table 4 shows the major steps taken for the Best Practice Pilot utilizing the Exapilot operation efficiency improvement package, which is procedural automation software.

**Table 4** Procedure of Best Practice Pilot

Step	Task items
Define	<ul style="list-style-type: none"> <li>• Determine the target operation (Start-up, feed change, etc.)</li> <li>• Determine the target of procedural standardization and automation (Energy saving, reduction of transient time, labor saving, etc.)</li> <li>• Set a quantitative target for improvement</li> </ul>
Measure	<ul style="list-style-type: none"> <li>• Obtain the SOP (Standard Operation Procedure)</li> <li>• Learn operation know-how from skilled operators</li> </ul>
Analyze	<ul style="list-style-type: none"> <li>• Define the best practice</li> <li>• Investigate automation of field devices</li> <li>• Allocate tasks between Exapilot and DCS</li> </ul>
Improve	<ul style="list-style-type: none"> <li>• Implement the best practice in Exapilot and test it</li> <li>• Modify the field devices and update DCS</li> </ul>
Control	<ul style="list-style-type: none"> <li>• Evaluate the improvement result</li> </ul>

**Lifecycle Effectiveness Services**

The Lifecycle Effectiveness Services support maintaining the effects of improvements achieved by Solution Implementation Services. As shown below, the benefits of solutions such as improving safety, improving productivity, improving availability of assets, and reducing TCO are periodically verified throughout the plant lifecycle.

- Regular Effectiveness Analysis  
Periodic site visits confirm the effectiveness of the improvement through Solution Implementation Services. Once degradation of performance is observed, Yokogawa would identify the causes of the degradation and propose another Solution Implementation Service.
- System Maintenance Proposal  
Yokogawa offers the optimal maintenance plan considering daily maintenance history, system malfunction trends, and customers' maintenance policy.
- Site Patrol for System  
Yokogawa engineers visit the customer's active site, check the system operational status and conduct simple inspections of the devices. Through a site walk, they will verify potential problems of the control system or their symptoms.
- Online Diagnosis of the System  
To verify potential problems of the system or their symptoms, information on system performance and the installation environment is periodically gathered and sent to a Global Response Center via the remote communication network for analysis.

**Table 5** IA systems and products for VigilantPlant Platforms

Perspective	Category / description		Examples of systems or products	
Securing Safety (Safety Excellence)	Independent Protection Layers	4th layer	Automatic Safety Instrumented System / Emergency Shutdown System	ProSafe-RS safety instrumented system
		3rd layer	Critical alarms differentiated from those activated by BPCS	AAASuite alarm rationalization assistance package software
		2nd layer	Basic Process Control System (BPCS)	CENTUM integrated production control system Consolidated Alarm Management Software (CAMS)
Optimal Production (Production Excellence)	Functional enterprise-control level	Level 3	Manufacturing Operations Management	ETSVision-Refinery total solution package for refineries
		Level 2	Batch Control, Continuous Control, Discrete Control	CENTUM integrated production control system Exasmoc multivariable model predictive control package Exapilot operation efficiency improvement package
		Level 1	Physical Production Process	DPharp pressure and differential pressure transmitters
Maximum use of plant assets (Asset Excellence)	-	-	PRM plant resource manager	

**VIGILANTPLANT PLATFORMS, THE FOUNDATIONS FOR VIGILANTPLANT SERVICES**

Table 5 shows the major systems and products included in VigilantPlant Platforms that cover almost all of Yokogawa's IA systems and products. Among them, this section introduces those which are most likely to be used for VigilantPlant Services.

- For securing safety (Safety Excellence)  
The Consolidated Alarm Management System (CAMS), which is an optional function of the CENTUM integrated production control system, properly manages alarms based on the ANSI/ISA18.2 <sup>(6)</sup> and IEC 61882 <sup>(7)</sup>. The AAASuite alarm rationalization assistance package software automatically suppresses alarm flooding during an abnormal situation of a plant. The ProSafe-RS safety instrumented system safely shuts down a plant in an emergency.
- For optimal production (Production Excellence)  
These IA products are the key infrastructures in level 1 to 3 of the functional enterprise-control model defined in ISA-95 (IEC 62264). The ETSVision-Refinery total solution model for refineries achieves flexible production in cooperation with a supply chain management (SCM) system by combining logistic information and plant control information in real time. The CENTUM integrated production control systems, Exasmoc, which is a multivariable model predictive control package, and Exapilot operation efficiency improvement package, which is procedural automation software, automate, stabilize, and optimize the plant operation. DPharp pressure and differential pressure transmitters ensure the accuracy and frequency of measurement values.
- For maximum use of plant assets (Asset Excellence)  
To maximize the use of plant assets, their reliability, availability, and serviceability must be kept at high levels. The PRM plant resource manager is the key product for this.

**CONCLUSION**

Yokogawa's new service brand "VigilantPlant Services" represents Yokogawa's strong commitment to serve customers as a lifetime partner for operational improvements by providing Yokogawa's extensive expertise developed in the selection, installation, expansion, modification, and maintenance of IA systems and products. We sincerely hope that this paper helps you clearly understand Yokogawa's new approach in which Yokogawa has stepped ahead from being a reliable product supplier toward the goal of becoming a reliable partner.

This special issue of Yokogawa Technical Report introduces some of the detailed service products included in the VigilantPlant Services as well as some solutions combined with Yokogawa's systems and products for certain industries.

Yokogawa will expand its service products according to customers' feedback and requests. We hope to serve as your total solution provider throughout for the life of your plant.

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