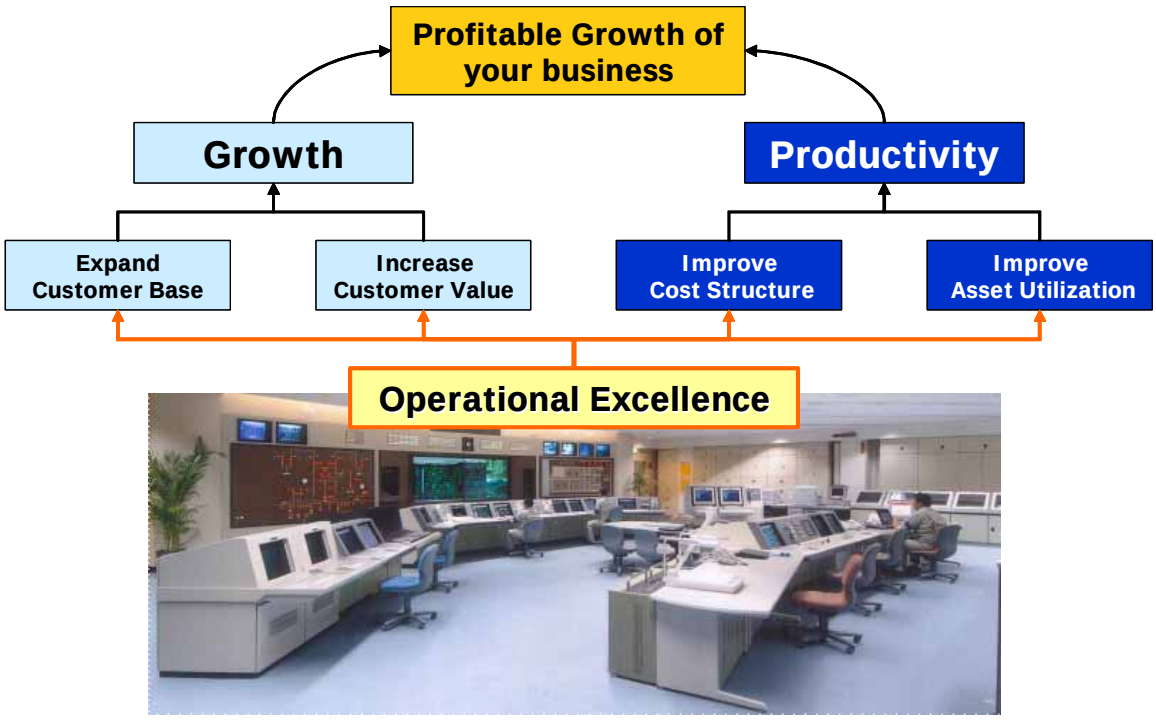
ARC WHITE PAPER

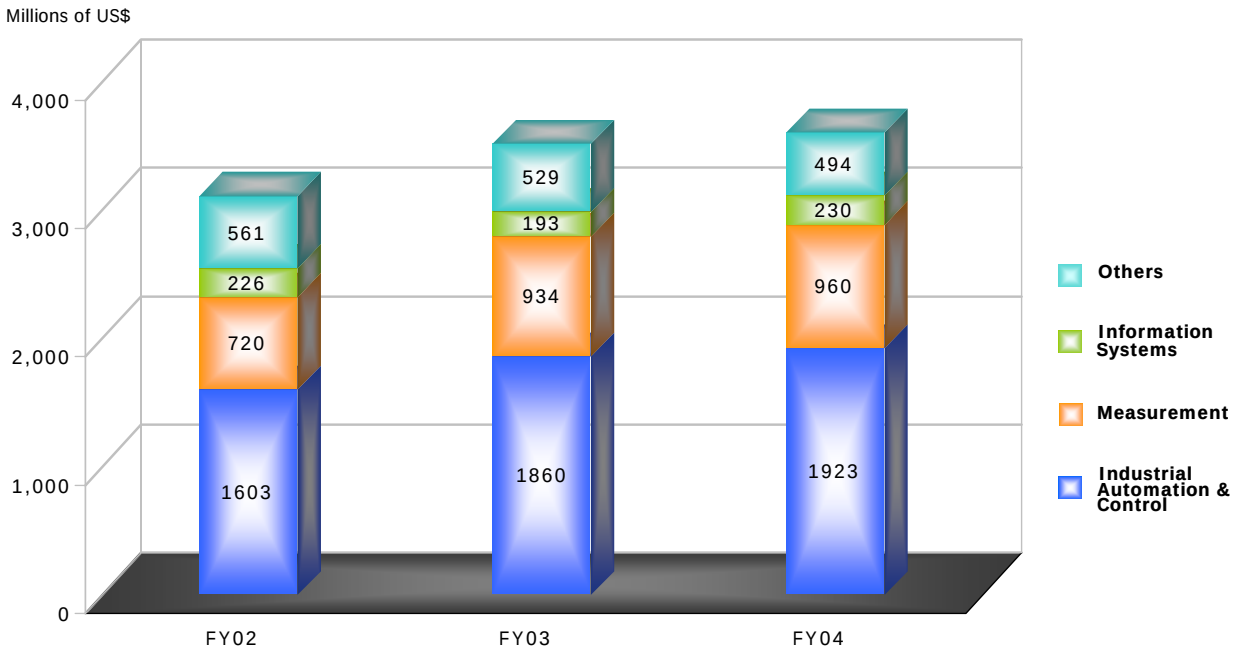
By ARC Advisory Group

FEBRUARY 2006

Yokogawa's VigilantPlant Road Map to Operational Excellence



Yokogawa's VigilantPlant Strategy is to Become a Business Partner With Customers by Driving Profitable Growth Through Operational Excellence



IA Business Sustains Yokogawa's Overall Growth

Executive Overview

In ARC's view, customers need a compelling business value proposition to justify investment in any kind of automation. Vigilance and VigilantPlant were created with this in mind. Yokogawa's vision with VigilantPlant is to create an environment where plant personnel and operators are well informed, alert, and ready to take action. Imminent abnormal events are detected well before they become a problem, and the role of the operator can be transformed from reacting to problems to making intelligent decisions about the process to optimize plant and business performance. VigilantPlant is rooted in the philosophy of Peter Drucker, who espoused that a well-managed plant is "silent and boring", where the role of the operator is transformed into that of a knowledge worker that spends more time optimizing production rather than reacting to emergent problems in the plant.

Yokogawa has developed a model for OpX based on its VigilantPlant offerings that allow users to place Yokogawa's capabilities in context with a real economic value proposition and business goal rather than simply evaluating features and functionality.

Yokogawa has developed a model for operational excellence (OpX) based on its VigilantPlant offerings that allow users to place Yokogawa's capabilities in context with a real economic value proposition and business goal rather than simply evaluating features and functionality. The model is based on three primary facets – Asset Excellence, Production Excellence, and Safety Excellence. Each of these facets corresponds to suites of product and service offerings under the VigilantPlant umbrella. Combined, these three facets create a path to lifecycle excellence, continuous improvement, and sustainability.

The Asset Excellence portfolio focuses on asset availability and utilization, which according to ARC research is an increasing concern for end users when they are trying to justify automation purchase decisions and strategy development. The Asset Excellence portfolio consists of offering such as Yokogawa's Plant Resource Manager (PRM), FieldMate, and fieldbus solutions. The Production excellence offerings focus on operational agility and adaptability, and include Yokogawa's suite of Exa production management offerings and related services, as well as Yokogawa's core system offerings under CENTUM CS 3000 and STARDOM. Safety Excellence offerings are focused on health, safety, and environmental concerns and are exemplified in Yokogawa's new safety system offerings, as well as software that is designed to prevent abnormal situations.

VigilantPlant Vision and Roadmap

Yokogawa has always been a company that offered superior technology and reliability, but experienced challenges in its ability to communicate its message and value proposition to existing and potential customers. Yokogawa took active steps to address these issues in 2003, when it embarked on a new corporate strategy called Vigilance that has refocused the company not only in terms of marketing, but has also enhanced the company's value proposition to the customer and its expansion into international markets outside of Japan.

The Vigilance campaign was successful at clarifying Yokogawa's message and value proposition to the customer, and honed in on the aspects of the security, dependability, and robustness of its systems and solutions. In 2004, Yokogawa launched a second phase of the Vigilance campaign called VigilantPlant, which raised customer awareness of Yokogawa's solution set and where it fits in the Vigilance scheme. VigilantPlant placed Yokogawa's solutions offerings in the context of an actionable strategy for operational excellence (OpX) within the manufacturing enterprise.

Today, with the Vigilance and VigilantPlant strategies firmly in place, Yokogawa has expanded its mission even further. At the company's 90th anniversary celebration in Tokyo in October of 2005, Yokogawa CEO Mr. Isao Uchida reiterated the message of the company to become the number one global supplier to the automation marketplace by 2010. The purpose of this white paper is twofold -- to examine how Yokogawa plans to meet this ambitious target, and to do so in the context of the company's VigilantPlant model for OpX.

In ARC's view, customers need a compelling business value proposition to justify investment in any kind of automation. Vigilance and VigilantPlant were created with this in mind. Yokogawa's vision with VigilantPlant is to create an environment where plant personnel and operators are well informed, alert, and ready to take action. Pending abnormal events are detected well before they become a problem, and the role of the operator

can be transformed from reacting to problems to making intelligent decisions about the process to optimize plant and business performance. VigilantPlant is rooted in the philosophy of Peter Drucker, who espoused that a well-managed plant is "silent and boring", where the role of the operator is transformed into that of a knowledge worker that spends more time optimizing production rather than reacting to emergent problems in the plant.

Building on this message, Yokogawa's philosophy with VigilantPlant is to become a business partner with its customers by providing them with the tools they need to drive growth and productivity to produce profitability with OpX as a foundation.

Yokogawa Reorganizes Business around Automation Core Competency

One of the more recent steps Yokogawa has taken to realign its business with the principles of its VigilantPlant philosophy is to reorganize its business model to emphasize its expertise in process automation. Along with an increased focus on providing value to its customers overseas, Yokogawa is also developing its project execution capabilities internationally. Currently, more than half of Yokogawa's engineering service experts are working overseas. Yokogawa has also formed engineering partnerships with companies such as ENGlobal and Applied Control Technology in the US. The company also established a new engineering center in Jebel Ali in the UAE that will more than double its engineering capabilities in the Middle East.

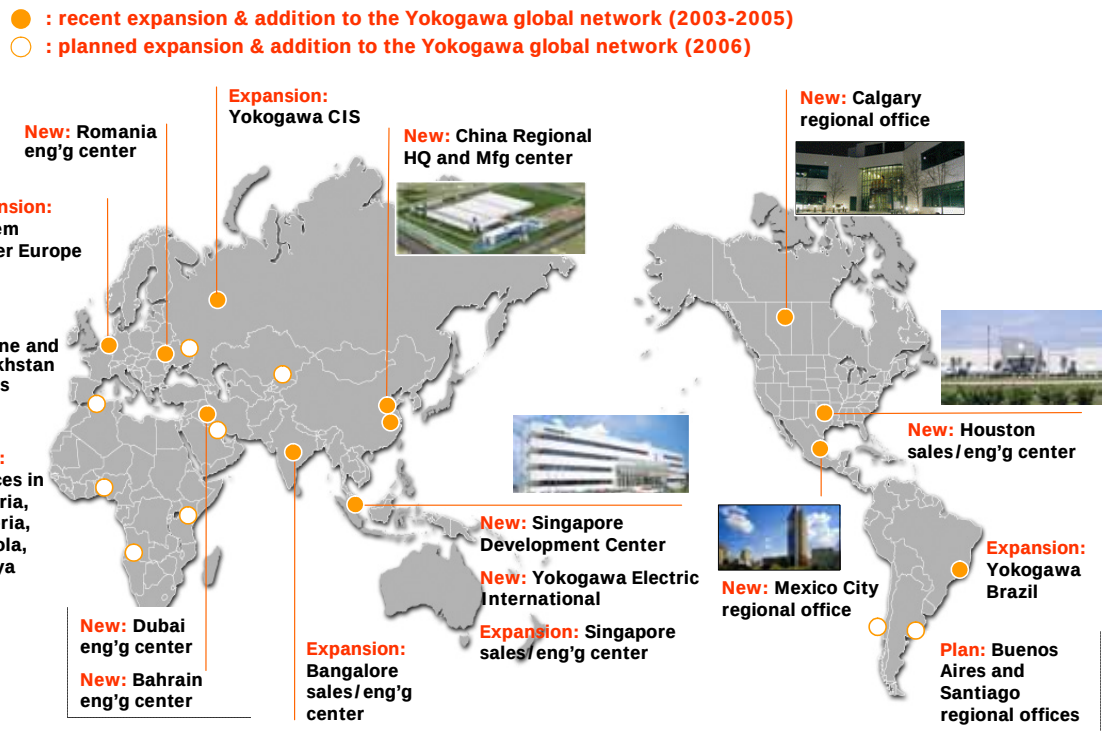
China is the growth engine for the global automation marketplace, and could possibly be the largest single automation market in the world within the next 20 years. Yokogawa realizes this and has invested heavily in its China business. The company now has nine operating companies in China. Yokogawa Electric China Co., Ltd. was established in Suzhou in 2003 as a major production facility for flowmeters and recorders for both the Chinese and worldwide markets. All of Yokogawa's production of magmeters globally has been sourced to Suzhou from Japan as a key step in increasing the company's cost competitiveness. Yokogawa China Co., Ltd. was established recently in Shanghai as a sales, engineering, R&D, and regional headquarters.

Yokogawa is Still a Technology Company at Heart

Yokogawa's products and applications are not just focused on automation, and the company is taking steps to increase synergies between its automation business and its businesses in test and measurement, medical imaging, and other businesses. One of the key aspects of Yokogawa's 90th anniversary celebration was an emerging technology showcase called Gateway to the Future that showed many of Yokogawa's products that are still in the R&D phase, such as wireless process sensors, IPv6 chips for field instrumentation, chemical microreactors, aircraft instrument displays, and even genetic diagnostics systems. It was unusual for a company to reveal so many new technologies that will probably not be commercially available for at least a couple of years and was a revealing look at Yokogawa's future direction in automation and all other areas of its business.

Yokogawa's Strategic Plan to Become Global Leader in Process Automation by 2010

Yokogawa's CEO Isao Uchida announced at the ARC Orlando Forum in February of 2005 that it was Yokogawa's goal to become the number one process automation supplier globally by the year 2010. More specifically, this means that Yokogawa plans to be the number one player globally in



Yokogawa Expands Its Engineering & Solutions Capabilities

process automation systems and key field devices, namely distributed control systems (DCSs), pressure transmitters, process analyzers, magnetic flowmeters, vortex flowmeters, and industrial recorders.

Becoming number one in all of these products segments is no small feat, particularly when one considers the company's position in markets such as DCSs, where it is virtually tied with Emerson and Siemens for the number four position in the worldwide market. Yokogawa, however, has a plan to reach its goal and has no qualms about sharing its strategy with the rest of the world.

The VigilantPlant Path to OpX

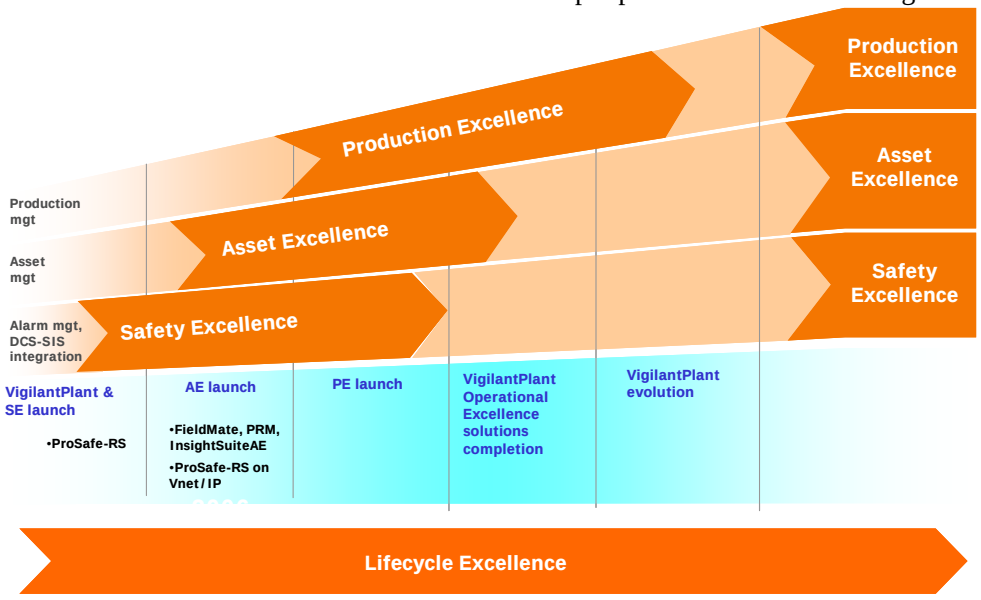
Yokogawa plans to achieve its goal by concentrating on core-value products, expanding its product portfolio, enhancing its fieldbus solutions, becoming more aggressive in its marketing initiatives, and expanding its services business. In the DCS business, the company plans on leveraging its strength in fieldbus installations, enhancing its competitive advantage by offering expanded capabilities in conjunction with its DCSs such as safety systems, production management applications, and driving growth in its STARDOM systems business for applications such as SCADA, and optimizing its product portfolio. From a vertical industry perspective, Yokogawa will focus more intently on its core sectors of chemical and refining, while penetrating growth markets such as pharmaceuticals and other batch applications and upstream oil and gas. Yokogawa also has expertise in power generation applications and is going to make power a key strategic growth segment globally.

While Yokogawa remains focused on growing its business in key growth markets such as China, India, the Middle East, and Russia, the company is also becoming more aggressive in building its share in the established markets of Europe and North America. The company has made significant gains in Europe over the past several years and is trying to replicate this same success in North America, moving its process automation headquarters from Newnan, Georgia to Houston. The company's DCS business outside of Japan has been growing at the average rate of over 20 percent

over the past several years, while its business for process automation products outside of Japan has grown at the average rate of over 13 percent.

The VigilantPlant Path to OpX

The current drive for OpX is a primary driver behind shifting end user purchase criteria for automation products, applications, and services. Yokogawa has developed a model for OpX based on its VigilantPlant offerings that allow users to place Yokogawa's capabilities in context with a real economic value proposition and business goal rather than simply evaluating features and functionality. The model is based on three primary facets – Asset Excellence, Production Excellence, and Safety Excellence. Each of these facets corresponds to suites of product and service offerings under the VigilantPlant umbrella. Combined, these three facets create a path to lifecycle excellence, continuous improvement, and sustainability.



VigilantPlant Operational Excellence Roadmap

The Asset Excellence portfolio focuses on asset availability and utilization, which according to ARC research is an increasing concern for end users when they are trying to justify automation purchase decisions and strategy development. For the majority of process automation users, the inability to build or install new assets makes existing assets more valuable than ever before. Yokogawa's Asset Excellence portfolio consists of offering such as Yokogawa's Plant Resource Manager (PRM), FieldMate, and fieldbus solutions.

The Production excellence offerings focus on operational agility and adaptability, and include Yokogawa's suite of Exa production management offerings and related services, as well as Yokogawa's core system offerings under CENTUM CS 3000 and STARDOM. Safety Excellence offerings are focused on health, safety, and environmental concerns and are exemplified

in Yokogawa's new safety system offerings, as well as software that is designed to prevent abnormal situations and also includes a wide range of services from safety system implementation to alarm strategy development.

Yokogawa is unique among process automation suppliers in that it has shared an overall strategic roadmap for the various aspects of the VigilantPlant Lifecycle Excellence. The full suite of VigilantPlant OpX solutions is scheduled for completion in 2008, with a continuing evolutionary path through 2010, when Yokogawa has simultaneously planned to achieve its leadership position in the worldwide process automation marketplace.

The Safety Excellence portion was launched in 2005 with the introduction of the ProSafe-RS safety system, AAASuite alarm management offering, and other aspects of the company's safety strategy. The Asset Excellence initiative was officially launched in 2006, and the Production Excellence initiative will launch in 2007. Many of the elements of these initiatives are already in place, however. The many production management applications offered by Yokogawa under the Exa suite of applications, for example, is an essential part of Yokogawa's Production Excellence strategy.

VigilantPlant Path to Asset Excellence

Yokogawa's Asset Excellence Strategy Enables Improved Asset Availability & Utilization

Users are focused on getting more out of their existing assets like never before. This includes getting maximum return on assets (ROA) and increased asset availability, or keeping an asset online for as long as possible while running that asset in an optimal state. The asset in this case could be process field instrumentation, control valves, rotating equipment such as pumps and compressors, and a myriad of other assets and plant equipment.

Yokogawa's VigilantPlant philosophy of See, Know, and Act fits well within the context of Plant Asset Management (PAM), because visibility into asset information is vital, knowledge of impending abnormal conditions or mechanical failure is imperative, and most important is the ability to take corrective action. Yo-

kogawa's PAM related applications, including Plant Resource Manager (PRM) and FieldMate, provide the needed visualization into plant asset conditions.

Yokogawa PAM Offerings Provide Visualization and Knowledge into Plant Assets

Yokogawa's PRM application provides visibility into plant assets, including field instrumentation, control valves, rotating equipment such as pumps and compressors, and other production-related assets. FieldMate, a new product from Yokogawa, offers a mobile solution for field asset management personnel to use that connects to multiple communication protocols. Yokogawa also offers value added software and services on top of its PAM offerings, dubbed PRM Advanced Diagnostic Applications or PAA, that allows users to optimize plant assets and implement predictive maintenance strategies, perform loop diagnostics, alarm optimization, and other functions, all under a philosophy of continuous improvement. InsightSuiteAE encompasses a series of services provided by Yokogawa to assist users in achieving an optimum PAM strategy, and includes things such as remote diagnostic and monitoring services.

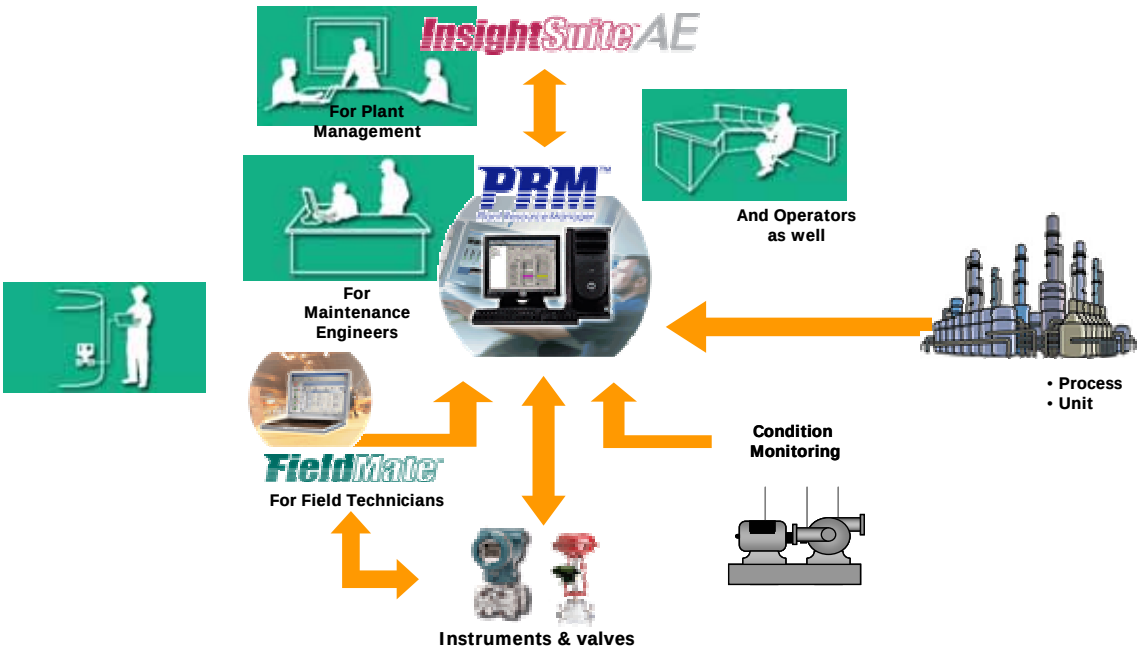
PRM enables centralized online monitoring of automation assets from the beginning of the project phase, and can help reduce commissioning and startup costs from the beginning of the asset lifecycle.

All of these offerings take advantage of the data that is available through digital field networks such as Foundation Fieldbus and other enabling technologies such as Field Device Tool (FDT). The pervasive link that ties all of these technologies together is Yokogawa's CENTUM CS 3000 system platform, which provides a single platform for integration of all data and provides the fieldbus host system interface.

PRM Provides a Single Window into Automation and Production Assets

Implementation of a PAM strategy should encompass the entire lifecycle of the device, not just capture data about the device after commissioning. PRM enables centralized online monitoring of automation assets from the beginning of the project phase, and can help reduce commissioning and startup costs from the beginning of the asset lifecycle. Online monitoring of device health and device/process interface conditions enables condition-based maintenance, helping to minimize both planned and unplanned downtime while reducing unnecessary field inspection.

PRM takes advantage of the industry standard Electronic Device Description Language (EDDL) technology supported by FF and HART, and can access all the functions parameters afforded by EDDL such as device ID, process measurements, and diagnostics capabilities. Yokogawa offers a series of "Plug-In" applications that can interface with PRM for functions such as valve monitoring and maintenance and advanced diagnostics. ValveNavi, for example, enables best practices for valve startup and adjustment. The DeviceViewer plug-in provides status, device-specific self-diagnosis information, and other diagnostic data for Foundation Fieldbus H1 devices.

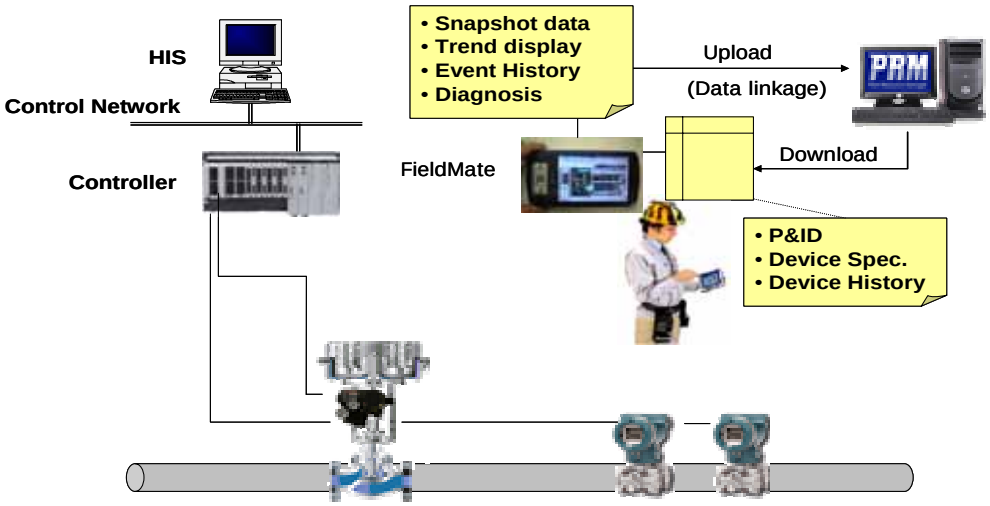


The Building Blocks of Yokogawa's Asset Excellence Offering

The latest version of PRM is PRM R3, which will be available in Q3 of 2006. PRM R3 brings a step change in its capability to create and integrate more advanced diagnostics applications. The PRM Advanced Diagnostic Application (PAA) environment facilitates diagnostics application development at the control loop and process unit levels, going beyond device health and device / process interface diagnostics. PRM R3 will also offer support for the Field Device Tool (FDT) open standard, integrating diagnostics applications collaboratively designed by fellow field device suppliers in the FDT Joint Interest Group. FDT support means that PRM will be able to access devices communicating across any communication protocol, including Profibus PA, ControlNet, and others.

FieldMate Provides a Portable Solution for Asset Maintenance Management

At Yokogawa's 90th anniversary celebration in 2005, the company introduced its new FieldMate FDT-compatible PAM solution. With Yokogawa's announcement of its membership in the FDT Joint Interest Group at Interkama Hanover 2005, the introduction of FieldMate represents a real commitment on the part of Yokogawa to the FDT concept, and proves that FDT and EDDL need not be competing technologies and can coexist in a single automation infrastructure.



FieldMate Provides Integration with PRM

With beta versions available today, FieldMate is a portable engineering and maintenance tool that supports both FDT and EDDL, and provides connectivity to PRM. Device Type Managers (DTMs) associated with FDT-compatible devices provide key device information and parameters. In addition to being compatible with Yokogawa DTMs, FieldMate also offers support for third party DTMs with Yokogawa interoperability verification, which will be provided through Yokogawa's new FDT/DTM interoperability verification center in Singapore, which opens in the first quarter of 2006. Yokogawa recently announced a new FDT/DTM partnership program, which also commenced operation in Q1 of 2006 as a multivendor program that is already under test marketing with a number of field device suppliers.

FieldMate is consistent with the PRM approach and VigilantPlant in that it is designed to serve as a single tool for maintenance of all intelligent devices over the entire device lifecycle, and provides a single traceable maintenance database offering explicit sharing of knowledge throughout

the enterprise. FieldMate is designed for use by Instrument Engineers, Maintenance Engineers, and Field Operators, and includes functions such as viewing, configuration, setting and tuning, audit trail, and diagnostics. The new application is designed to be field portable and provides linkage to Yokogawa PRM PAM application and other tools, as well as compatibility with PDAs and other wireless devices.

PRM Advanced Diagnostic Applications

The ultimate goal of any PAM application offering is to provide a means of going beyond predictive maintenance strategies and establishing a truly proactive maintenance strategy, where impending events and their root causes can be detected and acted upon before they become a threat to continued operations. Effectively predicting failure is only half of the equation, however, since a truly predictive maintenance strategy also serves to keep assets running at maximum efficiency for maximum asset availability – the "Silent and Boring" plant that was a foundation for Peter Drucker's philosophy of OpX.

Yokogawa is introducing a suite of applications called PRM Advanced Diagnostics Applications (PAA) that address the "Know" and "Act" portions of the VigilantPlant philosophy and provide a platform for truly proactive maintenance by detecting the current health of plant assets through a lifecycle-based approach to condition monitoring. PAA also predicts future asset availability, and provides guided steps for best practices in dealing with preventive action that can be used by both operations and maintenance. This guided approach fits with ARC's view that best practices should be embedded into automated work processes for plant personnel to assure plant availability.

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PAA uses mathematical and statistical calculations with data and parameter utilization from DCS data, field device parameters, and other data sources such as third party equipment and machinery. Users can take advantage of Yokogawa's own PAA functions or they can create their own through the PAA Development Environment.

From an architectural standpoint, PAA includes an Advanced Diagnostics Client that incorporates functions such as a diagnosis navigator, trend graphs, and support for Microsoft Excel. An Advanced Diagnostics Historian provides a central data repository. The Historian takes data from the

Advanced Diagnosis Server and Data Acquisition Service. The Advanced Diagnosis Server interfaces to the DCS historian and the Advanced Diagnostics Development Tool, while the Data Acquisition Service interfaces to the Field Communications Servers to get data regarding intelligent field instrumentation.

Some of the diagnostic application samples that will be available with PAA include valve travel and actual flow rate monitoring; a valve total works monitor; steam trace group check; and steam trace point check. Sample diagnostics templates include upper/lower limit check, range monitoring, monitoring of differences between multiple devices, and monitoring of error with reciprocating compressors.

InsightSuiteAE Provides Value Added Software & Services

Because of continuously shrinking resources, users are outsourcing an increasing amount of services that were once provided in-house. InsightSuiteAE is a new suite of services offered by Yokogawa as part of their Asset Excellence strategy. Services can be provided through Yokogawa's new Global Response Center, and include remote on-line monitoring and diagnostics of customer systems. Offline analysis is also available, as are other training and visualization services.

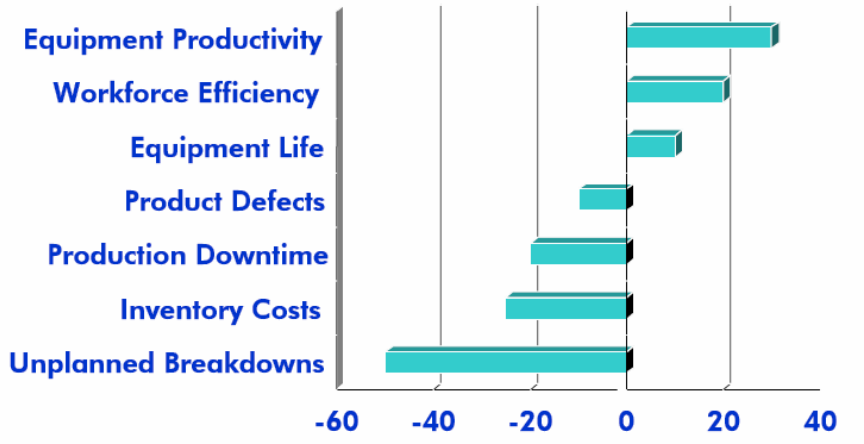
Mapping ARC Vision of PAM to VigilantPlant

ARC believes that PAM solutions embedded in automation systems and enriched by new asset monitoring technologies are evolving beyond traditional predictive maintenance into an indispensable source of information for plant operators. PAM solutions provide operators with valuable insight necessary to operate today's complex production plants effectively. With the aid of real-time PAM information, plant operators can extend the life of assets and improve productivity, efficiency, and plant availability. The bottom line benefits of implementing a PAM solution can be significant. ARC's analysis shows that end users can realize up to a 50 percent reduction in unplanned shutdowns, significantly reduced inventory costs, and up to a 30 percent increase in equipment productivity.

ARC has long stated that the real benefit of fieldbus technology lies in its ability to enable advanced asset management and predictive maintenance strategies. The deployment of a PAM application in fieldbus installations, such as PRM and FieldMate, can help to realize this vision. In ARC's view, Yokogawa is one of the strongest supporters of Foundation Fieldbus today

and provides a holistic approach to asset management from the control system down through the device level.

Remote diagnostics and maintenance capabilities continue to be primary selection criteria for most users that purchase fieldbus control systems. In ARC's view, however, most users do not follow through on the asset management capabilities of fieldbus when used in conjunction with a PAM application. Too much time can be spent focusing on the initial cost of a project and the reduction of capital spending than the cost of ownership of return on assets (ROA) that can be achieved using PAM and fieldbus. The fact that Yokogawa bundles PAM functionality that spans the lifecycle of the asset allows the user to take an instrument lifecycle approach to implementing a PAM solution, and also makes it easier to implement a lifecycle-based maintenance strategy versus a reactionary or simply preventive strategy.



Percent Improvement Of PAM Implementation Over Traditional Reactive Maintenance Strategy

VigilantPlant Path to Production Excellence

Yokogawa has a wide range of production management and MES solutions ranging from plant information management systems (PIMS) and advanced process control (APC) to operator assistance solutions. The company's goal with VigilantPlant is to consolidate these offerings under a single unified umbrella. Yokogawa's VigilantPlant model of See, Know, and Act fits into ARC's view of the Collaborative Production Management (CPM) marketplace, which consists of the three-step process of planning, informing, and optimization.

The "See" aspect consists of the visualization of plant performance data through plantwide data transparency and information integration to reduce blind spots. The "Know" aspect provides users with the ability to make fast and intelligent decisions about production with analysis and decision support tools to synthesize plant information and human knowledge. The "Act" phase consists of tools to optimize plant performance that provide effective guidance to the appropriate plant personnel, from operations to management.

Yokogawa Production Management Roadmap

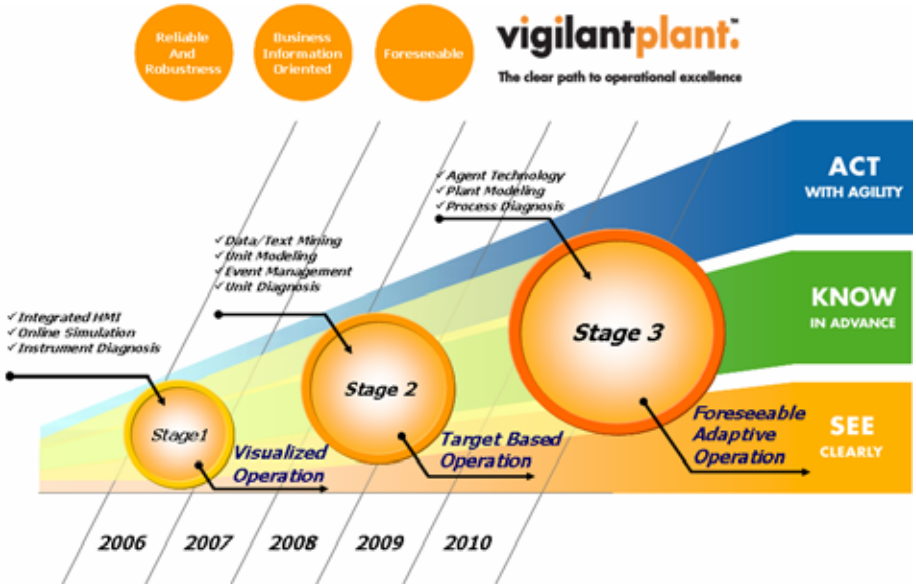
Yokogawa's roadmap for its CPM strategy is divided into three stages that evolve over the next several years. The current stage focuses on Visualized Operation, and encompasses Integrated HMI, Performance Monitoring, and Instrument Diagnosis. Stage 2, which will take place between 2007 and 2009, moves toward a philosophy of target-based operation and incorporates new technologies such as Data and Text Mining, Process Unit Modeling, Event Management, and Unit Diagnosis. Stage three moves to an all-encompassing philosophy of foreseeable, adaptive operation and incorporates agent technology, plantwide modeling, and process diagnosis.

VigilantPlant Model for Production Excellence Provides Operational Agility & Adaptability

In the current stage of Visualized Operation, Yokogawa intends to provide users a path to predictive performance monitoring by way of new equipment monitoring solutions that use simplified dynamic simulator, which predict deterioration of performance and help to minimize downtime and reduce maintenance costs. The real-time information visibility piece of VigilantPlant Production Excellence is rooted in the integrated HMI that is part of Yokogawa's CENTUM CS 3000 process automation system. The integrated HMI provides access to the decision support environment consisting of Yokogawa's applications and solutions offerings such as advanced control, scheduling, production analysis, process monitoring, and performance monitoring.

Yokogawa's Exa Suite of Applications

Yokogawa's CPM offerings consist of the Exa suite of CPM applications. Yokogawa's PIMS offerings are represented by the Exaquantum and Exaquantum/Batch applications. Exaquantum is a platform used to acquire data from all facets of a business and the subsequent transformation of that data into easily usable, high-value, widely distributed information. Comprehensive, operator specific historization and archiving of many data types is available, as well as statistical process control (SPC) capabilities. Exaquantum/Batch is an S88-based batch information system that provides analysis and reporting facilities that collect, store and display current and historical data from batch production, equipment, and recipe viewpoints.



Yokogawa's Three-Phased Evolutionary Roadmap for Production Management

Yokogawa Moves from Production Management to Knowledge Management

Yokogawa's production management solutions take advantage of the convergence of business, automation, and demographic workforce changes that will provide a catalyst for a new era of manufacturing. Until recently, a company's success relied heavily upon individual knowledge scattered throughout its organization. To sustain competitive advantage organizations must leverage their knowledge base in conjunction with preparing for the Next Generation of Manufacturing. This is the central tenet of ARC's concept of Knowledge Management (KM). KM builds on the data collection aspect of production management that provides an understanding gained through experience, study, or association. KM embodies the creation, capture, and reuse of knowledge, and enables improvements of both human and physical assets where the analysis and transformation of pro-

duction data into the appropriate business context results in reduced operating costs and improved product quality.

Manufacturers are redefining the roles of operators and other personnel as the loss of experienced workers forces companies to use team-based approaches. To reduce variability in production, manufacturers are also reducing the dependency upon operator skill level. Intelligence in automation equipment enables unattended control, while allowing the operator to focus on their new role as an intangible that has the experience and the right tools to function as a sensor in the production process. A "conscientious worker" is required that is capable of acting as the first alert to impending problems.

Yokogawa's approach to production management fits into a model for knowledge management because of its ability to facilitate the process of knowledge capture and creation.

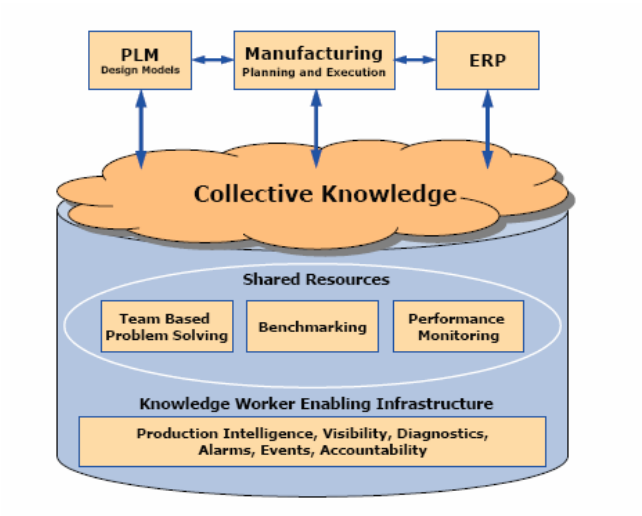
The reliance upon a team based approach and enhanced human performance is where KM will have the greatest impact. Organizations must approach Knowledge Management as a collective enterprise resource in conjunction with the addition of embedded intelligent automation with increasing awareness of the processes being controlled. ARC views the two approaches as complementary rather than being independent and should be viewed this way.

Yokogawa's approach to production management fits into a model for KM because of its ability to facilitate the process of knowledge capture and creation. The operational agility and adaptability promised with the VigilantPlant model for production excellence cannot be achieved without providing operators and plant personnel with the knowledge they require to make intelligent decisions.

Exapilot is a good example of a knowledge management tool that is available from Yokogawa today. Exapilot is an operational efficiency improvement application that captures the knowledge of experienced operators and incorporates that into standard operating procedures and work processes. Exapilot essentially allows users to automate DCS-related work procedures such as setting valve openings, startup, level checks, and pump starts and stops. Operating procedures can be represented in the form of graphical icons that can be linked in sequence to create a string of standard operating procedures with prompts to ensure that operators do not omit steps.

SAP / Yokogawa Partnership for Adaptive Manufacturing

Yokogawa announced support for ISA 95 in 2004, and currently supports the ISA 95 standard as the basis of its CPM-ERP integration strategy. The first pilot implementation of a Yokogawa / SAP ISA 95 based interface was demonstrated at Interkama 2005. The company also developed B2MML schemas for the World Batch Forum (WBF).



Manufacturers Must Begin To Capture And Share knowledge And Best Practices Across The Enterprise

Yokogawa joined the SAP "Powered by Netweaver" program to seal their official partnership with SAP in 2005. Yokogawa has developed an ISA-95 package using B2MML in mySAP's Exchange Interface (XI), which is scheduled to be certified by SAP, through the SAP Certification Centre in Palo Alto, in March 2006. The application provides an integration platform for CENTUM CS 3000, Exaquantum and mySAP. The solution enables adaptive manufacturing by providing 'Application to Application' (A2A) and 'Business to Business' (B2B) integration of manufacturing data and exception reporting into the SAP environment to close the loop between the factory and the enterprise.

VigilantPlant Path to Safety Excellence

A significant component in the VigilantPlant scope of offerings is Yokogawa's new approach to safety systems and safety instrumented systems (SISs). Yokogawa is undergoing a major repositioning and evolution of its safety system business to fulfill the vision of VigilantPlant and provide users with increased visibility into plant operations and the ability to take action before problems arise. Yokogawa's new approach to safety systems addresses the company's belief that safety systems still lack much of the advanced functionality found in DCSs, such as a unified architecture, integrated HMI, and integrated alarming capabilities, all of which provide the business value proposition of reduced unplanned downtime, lowered total cost of ownership, and increased return on assets.

Just as it is with the Asset Excellence and Production Excellence models, Yokogawa's approach to Safety Excellence fits into the VigilantPlant model of See Know and Act. The "See" aspect consists of monitoring plantwide process conditions by integrated monitoring of plantwide alarms and events. The "Know" aspect consists of detection of critical conditions and emergency avoidance through prioritization and role-based notification of predictive alerts. The "Act" aspect consists of the ability to optimize operation and safeguarding through providing effective and proactive guidance to operators and safety experts.

ProSafe-RS Safety Platform Is Core of Safety Excellence

Yokogawa's new safety system is called ProSafe-RS (Responsive Solution), and was released for shipment around the end of the second quarter in 2005 with full TÜV certification for SIL 1, 2, and 3. ProSafe-RS features a unified architecture with the CENTUM CS 3000 system, and fulfills ARC's safety system vision of "separate yet integrated" safety systems, where the safety system is logically separated from the process automation system, but both are integrated into one system. ProSafe-RS continues to evolve.

VigilantPlant Path to Safety Excellence Provides A Platform for Abnormal Situation Avoidance

Enhancements in 2005 included the incorporation of a Vnet/IP router, Modbus master; relay boards for digital outputs, and performance improvements in safety communication. Planned evolution for 2006 includes ABS, Lloyd's, BV, and FM certification. Analog input and output for HART, remote I/O, and full Vnet/IP functionality are also planned for 2006. The platform is planned for a major evolution in 2007 with incorporation of Foundation Fieldbus SIS functionality, sequential function charts, a conversion tool for Yokogawa's ProSafe-PLC legacy safety platform, and an SCS simulator.

Yokogawa Roadmap for Safety Excellence

Within a larger context, Yokogawa has a well-developed roadmap for their overall direction in Safety Excellence that reaches out to 2010. The big steps in 2006 are the incorporation of safety loop integration, which includes integration of safety transmitters and valve partial stroke testing. By 2010, Yokogawa plans to integrate alarm and event (A&E) notification as well as centralized alarm monitoring.

Alarm Management and Safety System Integration

Yokogawa's philosophy of Safety Excellence goes beyond the safety system platform to take a more holistic approach that provides a platform for Critical Condition Management (CCM). A CCM platform incorporates not only the safety system platform, but provides functions such as predictive alarm detection, deductive alarm notification; significant levels of personnel guidance, and operator initiated corrective actions.

Integration of alarms and events notification in the context of Yokogawa's Safety Excellence approach addresses many of challenges that user face today when it comes to managing alarms. In the dawn of process control, alarms were usually simple Hi/Lo alarms and the operator was notified through small annunciator panels. Alarms were also primarily limited to safety applications. The cost of implementing alarms was also relatively high. Today's process automation systems, however, have made the cost of implementing alarms almost nil, which has resulted in a plethora of alarms throughout the plant. Many of these alarms are also not strictly related to safety, and include domains such as safety, device ability, and other functions. Alarm management applications have also become increasingly advanced, providing functions such as predictive and statistical diagnosis. The number of users that require alarm data has also expanded from the operator to include maintenance personnel, process engineers, and others.

Yokogawa's philosophy of Safety Excellence goes beyond the safety system platform to take a more holistic approach that provides a platform for Critical Condition Management (CCM).

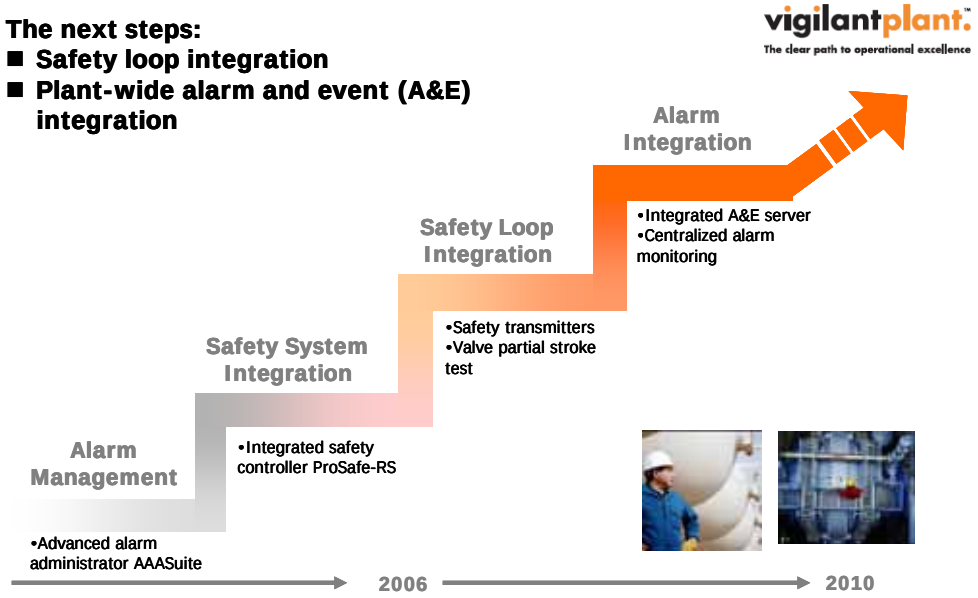
Alarm Management solutions consist of a bundle of best practices and tools that enhance operational performance by improving the effectiveness of alarm systems. Most modern Process Automation Systems (PASs) contain alarm management software that allows for grouping of alarms. Not all suppliers, however, offer equally comprehensive alarm management functions. Some alarm management strategies, while comprehensive, may be extremely complex to use.

Yokogawa offers an alarm management solution that focuses on ease of use and provides a full suite of tools and capabilities from basic alarm suppression to dynamic alarm optimization. Called AAASuite, the primary functions of Yokogawa's new alarm management package are to identify problems with alarms and execute basic remedies, treat causes of alarm occurrence, and eliminate alarm overload. Yokogawa's substantial

engineering services capabilities for alarm management are also part of the AAASuite offering.

Alarms are often used to trigger an interlock sequence for applications such as emergency shutdown. Operators must detect these alarms before the process reaches the critical point where this interlock is executed, and alarms should be set at the point where the operator has the ability to take action. If alarms are set too conservatively, then they are triggered within normal operating parameters. Conversely, if alarms are set outside the normal operating range of the plant, it is too late for the operator to take action. AAASuite can trigger predictive alerts before the process reaches the shutdown phase. AAASuite provides various kinds of advanced alerts as a template.

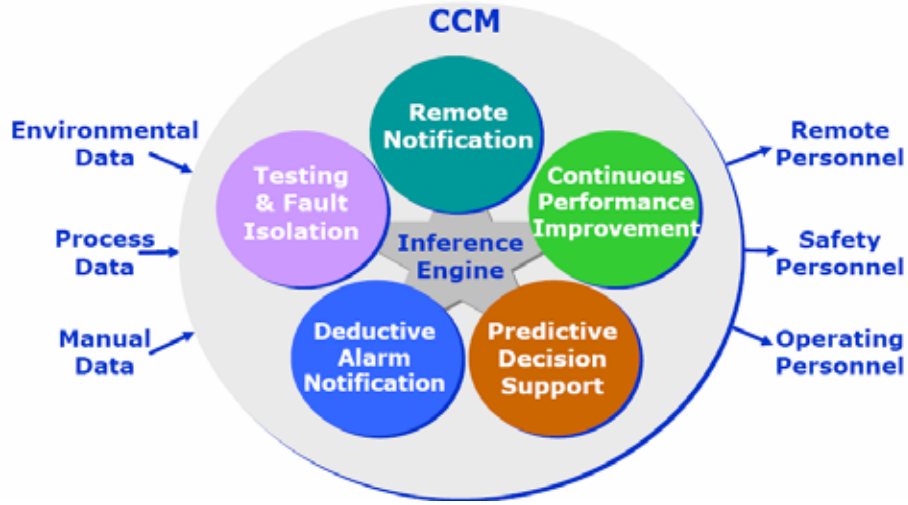
Yokogawa's roadmap for alarm management functionality is to provide a new generation of real-time alarm system to realize safer and more profitable production. This will be realized in the form of an alarm information integrator that incorporates the advanced functionality of AAASuite, placing the application's multi-purpose clients, intelligent alarm distributors, advanced alarm generators, and alarm information normalizers / optimizers in the context of a unified framework.



Yokogawa Roadmap for Safety Excellence

Mapping ARC Vision of Critical Condition Management to VigilantPlant

ARC's model for Critical condition management (CCM) rests on the principle that a CCM system works in an anticipatory mode across the many protection layers of a plant, providing guidance to the operating and safety personnel. The major CCM functions can be categorized as deductive alarm notification, predictive decision support, personnel guidance, remote notification, and disaster recovery guidance. These functions usually operate in a knowledge base environment with an inference engine. In the past, major manufacturers pursued custom implementation of critical condition management functions.



ARC Model For Critical Condition Management (CCM)

Yokogawa's vision for CCM is consistent with ARC's because the company has adopted a common architecture for both safety systems and control systems, with logical separation as required. On top of this, Yokogawa has layered tools for effective alarm management strategies that enable users to comply to the EEMUA standards for alarm management.

Yokogawa Combines Device and Safety Expertise for SIS Solution

The main cause of an SIS failure is not the failure of logic solvers, but the failure of field devices. In the recent years, there has been a significant advance in the development of the architecture of logic solvers with voting circuits and advanced diagnostics. However, they do not address over 90 percent of the causes for failure, which are due to the failure of field devices.

Yokogawa's safety system strategy addresses the requirements for an intelligent Safety Instrumented System (SIS) by checking the health of the I/O and field devices. Some of the key functions incorporated by Yokogawa

that correspond to ARC's vision of safety instrumented systems include:

- Sensor validation through PRM.
- Environment condition monitoring, such as temperature and humidity that can cause sensor degradation through intelligent field instrumentation.
- Impulse line blockage monitoring.

Common cause failures of electronic components are frequently due to environmental conditions. Many electronic device failures are due to elevated humidity and temperature, which need to be monitored closely. Sensor calibration is also becoming an integral part of a safety system. Use of protocols, such as HART, Profibus, and Foundation Fieldbus and unifying technologies such as FDT allow for remote monitoring, diagnostics, and validation.

Yokogawa's safety system strategy addresses the requirements for an intelligent Safety Instrumented System (SIS) by checking the health of the I/O and field devices.

Users must also keep in mind that Profibus PA and Foundation Fieldbus are in the process of undergoing TÜV certification, and it will soon be possible to construct safety instrumented systems using fieldbus-compatible instrumentation. The incorporation of fieldbus into SIS strategies will provide a completely new level of diagnostics and will provide better information to alleviate unplanned shutdowns and the emergence of abnormal situations. Yokogawa's emphasis on fieldbus solutions and the predictive diagnostics that go along with it are two key advantages for the company in developing their SIS strategy for the future.

VigilantPlant At Work

Increased vertical industry focus has been a necessary step for all major suppliers in the past several years. The ability of automation suppliers to help their customers achieve a level of operational excellence is in direct proportion to the supplier knowledge and commitment to the various industry segments that they serve. This means that suppliers must continue to build vertical industry expertise and they must choose the strategic vertical industry segments they want to target. Yokogawa continues to strengthen their vertical industry expertise in their core

markets of refining and petrochemical, but the company is also expending their presence in key growth markets such as pharmaceuticals, power generation, and upstream oil and gas.

Yokogawa's Integrated Solution Capabilities Showcased at CSPC Nanhai Project

Yokogawa's ability to provide integrated solutions and comprehensive services is showcased in the company's role as Main Automation Contractor (MAC) for CNOOC and Shell Petrochemicals Limited new integrated refining petrochemical complex in Guangdong, China, also known as the Nanhai Project. The new integrated petrochemical complex was successfully started up at the end of 2005. As MAC, Yokogawa is coordinating operations between six international engineering contractors, Chinese design institutes, and many other subcontractors and serves as a single point of responsibility to streamline project management and facilitate deadline requirements.

CSPC Nanhai Control Room

With only three years from front-end engineering and design (FEED) to completion, this is an ambitious schedule and so far, the project is operating on schedule. The Nanhai Project is notable for many reasons, and will be the largest Foundation Fieldbus installation in the world upon completion, with a total of 16,000 devices, 3 control rooms, 15 field auxiliary rooms, and 200,000 software tags.

VigilantPlant Strengths & Challenges

It is not easy for a supplier to place their products and solutions into a framework for OpX. Many companies have tried to place their products in such a context before without much success. Today's manufacturing end users are finding it increasingly difficult to justify automation investments without a case for business value and are looking more than ever at the bottom line economic impact of automation. VigilantPlant has so far been successful in placing Yokogawa's offerings in the context of a pathway to OpX for its customers. Yokogawa has truly "discovered marketing", and must not lose this focus of proactively and intelligently marketing its products, applications, and services.

Yokogawa is unique among automation suppliers in that it is willing to share detailed roadmaps for its asset, production, and safety excellence offerings. The drive to reach the goals laid out in these roadmaps will be a challenging one and will require significant investment in research and development and a significant overall commitment to maintaining a consistent vision throughout the next several years. Enhancements will need to be made continuously for the company to remain competitive.

At the same time however, Yokogawa must continue to release new products, and this balance between core products and new products requires careful handling. The company must also continue to build on its adherence to standards such as the IEC fieldbus standard, ISA 95, and the many other standards incorporated into the company's products.

It will also be a challenge for Yokogawa to reach its other stated goal of becoming the number one supplier for the process automation marketplace worldwide by 2010. Sustained growth of 10 percent or more through the next several years is possible, but only if the company stays on track and continues to build on the successes it has made for itself in the past couple of years.

The company must continue to build its installed base worldwide and become more aggressive when it comes to winning new business and new customers. Balancing the requirements of a considerable installed base while cultivating new business will be a challenge. Yokogawa's existing customers will be just as important a source of business for the company as new clients, since many of the products and services the company is selling through VigilantPlant are designed to provide OpX just as much during the operational phase of the plant as they are during installation, commissioning, and startup.

VigilantPlant Strengths	VigilantPlant Challenges
Well-Developed Long-Term Roadmaps	Must Honor Commitments Presented in Roadmap
VigilantPlant Places Yokogawa Offerings in an Actionable Context for OpX	VigilantPlant Message Will Require Continuous Refinement
Strong Installed Base	Must Balance Installed Base With New Business Growth
Sustained Investment in R&D	Must Continuously Introduce New Products to Remain on Growth Track

Yokogawa VigilantPlant Strengths & Challenges

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Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/Community/terms/terms.htm

AI	Artificial Intelligence
APC	Advanced Process Control
APS	Advanced Planning & Scheduling
B2B	Business-to-Business
B2MML	Business to Manufacturing Markup Language
BPM	Business Process Management
CAGR	Compound Annual Growth Rate
CAS	Collaborative Automation System
CCM	Critical Condition Management
CNC	Computer Numeric Control
CPG	Consumer Packaged Goods
CPAS	Collaborative Process Automation System
CPM	Collaborative Production Management
EAI	Enterprise Application Integration
EAM	Enterprise Asset Management
ERP	Enterprise Resource Planning
HMI	Human Machine Interface
IT	Information Technology
KM	Knowledge Management
LAN	Local Area Network
MIS	Management Information System
MRP	Materials Resource Planning
OpX	Operational Excellence
OLE	Object Linking & Embedding
OPC	OLE for Process Control
PAM	Plant Asset Management
PAS	Process Automation System
PLC	Programmable Logic Controller
ROA	Return on Assets
ROI	Return on Investment
RPM	Real-time Performance Management
SCE	Supply Chain Execution
WAH	Web Application Hosting
WMS	Warehouse Management System

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