

## ARC WHITE PAPER

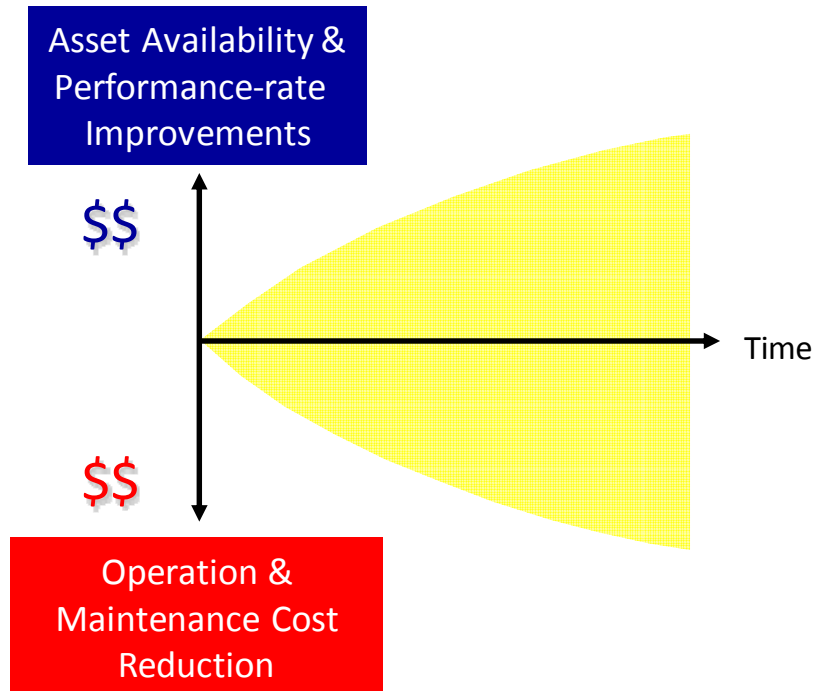
By ARC Advisory Group

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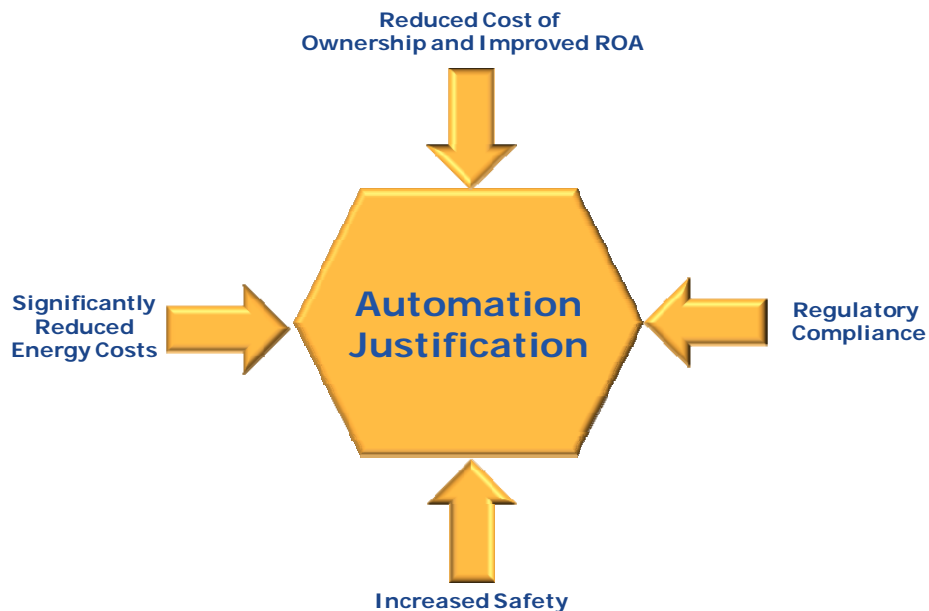
### **Yokogawa vigilantplantservices®: Using Applied Industry Knowledge to Solve Key End User Issues**

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**InsightSuiteAE is a Key Aspect of VigilantPlant Services and Provides Increased Asset Availability & Performance with Cost Reductions**



**The Overwhelming Value Proposition for Justifying Automation Must Include Significantly Reduced Energy Costs, Increased Safety, Improved Regulatory Compliance, Reduced TCO, and Improved ROA**

## Executive Overview

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The automation suppliers that will be successful in the long term will be those that effectively address application or industry specific problems for end users with a value proposition that cannot be ignored. These problems exist throughout the process industries today, and they won't be solved by

CombustionONE and InsightSuiteAE are great examples of how Yokogawa VigilantPlant Services can combine hardware, software, applications expertise, and services to solve some of the most persistent and costly problems in the process industries today.

simply offering a product, but through a combination of hardware, software, services, application expertise, and knowledge.

Many of the challenges in the process industries today can be traced not to controls and automation but to plant equipment. Fired heaters, dryers, heat exchangers, and other pieces of plant equipment pose a series of problems from safety risks to poor energy efficiency. Fired heaters, for example, are the largest overall energy consumer in the process industries and represent a tremendous opportunity for energy savings. Fired heaters also present a huge safety risks during startup and shutdown. Anything involving a combustion process represents an opportunity for improved control and energy efficiency.

Yokogawa is one process automation supplier that is combining their resources in hardware, software, and services to target these specific problems in the process industries to offer a comprehensive solution. Having the right applications and products is essential for addressing these industry issues, but it is really the company's service capabilities that are the prime differentiator and which ensure the long-term success of the solution. Through its VigilantPlant Services business unit, Yokogawa combines services and solutions to support manufacturers in their continuous improvement activities throughout the plant lifecycle.

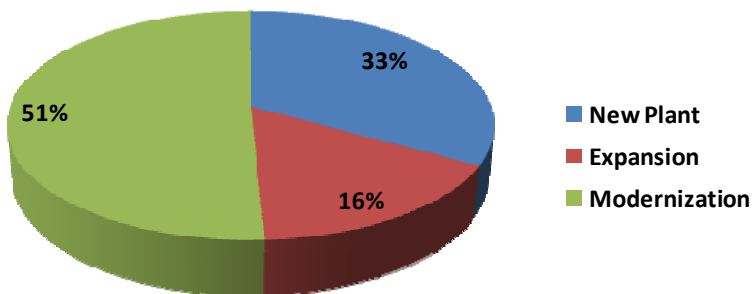
This paper focuses on two key areas where Yokogawa is distinguishing itself in terms of an ongoing service-based value proposition to process industry end users that address many longstanding challenges -- CombustionONE and InsightSuiteAE. CombustionONE combines Yokogawa's expertise in tunable diode laser (TDL) analytical devices and other equipment along with applications, services, and ongoing maintenance and support capabilities to revolutionize the way end users manage their fired heaters and combustion processes. InsightSuiteAE combines Yokogawa's

advanced application expertise with its service capabilities to provide a solution for Overall Equipment Effectiveness (OEE) that addresses many key process industry applications such as dryers, heat exchangers, and furnaces and boilers. The business value proposition behind these solutions is a powerful one, with returns sometimes measured in days, not months.

## End Users Need an Intelligent Approach to Operational Services

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The automation business tends to focus a lot on capital projects, but it is the operational phase of the plant that really drives the process industries. This is reflected in many of the current dynamics of the process automation marketplace. The process automation systems market is driven by the installed base, with half the market dedicated to modernization of existing



systems and another 16 percent dedicated to expanding capacity at existing facilities.

The lifecycle cost of a process automation system is, according to the ARC rule of thumb, four and half times that of the applied cost.

While there are opportunities to reduce project costs significantly, there is an even bigger push in the industry today to increase operational efficiency, reduce lifecycle cost, and improve the performance of existing automation assets. But we are not talking improving performance for the sake of performance. There has to be a solid economic value proposition associated with any improvements to be made.

## In a Tight Capital Market, Returns Must be Quick and Significant

Companies today are holding onto their cash and it is more difficult than ever to justify automation projects. To compound matters, end users are expecting even shorter returns on their automation investment. A return on investment in as little as three months is not uncommon. Unfortunately, in many cases the immediate return on investment calculation can be diffi-

cult to arrive at. A strong value proposition is one that cuts across areas such as productivity, reduced installed cost, reduced operational cost, and increased regulatory compliance. A good value proposition is, in other words, one whose impact is overwhelmingly positive and measurable with a very quick return.

### It's All About the Assets, and Assets Require Solutions

For such an overwhelming value proposition to exist in the process industries, it must somehow be tied to manufacturing assets. The process industries are extremely asset intensive. Manufacturing assets usually represent 75 percent of a process company's

entire assets, while manufacturing typically accounts for 65 percent of a process company's cost of sales. Simply providing a product or an application is going to do little to solve the real problems that exist with today's plant assets. They are too complex and the people issues faced by many end user companies usually mean that there are less experienced personnel to deal with these assets and their proper function. This leaves a large opportunity for the process automation suppliers to combine their products and applications with their own service capabilities and in-



**The VigilantPlant Path to OpX Incorporates Asset Excellence**

dustry expertise to provide solutions that transcend simple control or measurement and provide a step change in asset performance and overall plant performance.

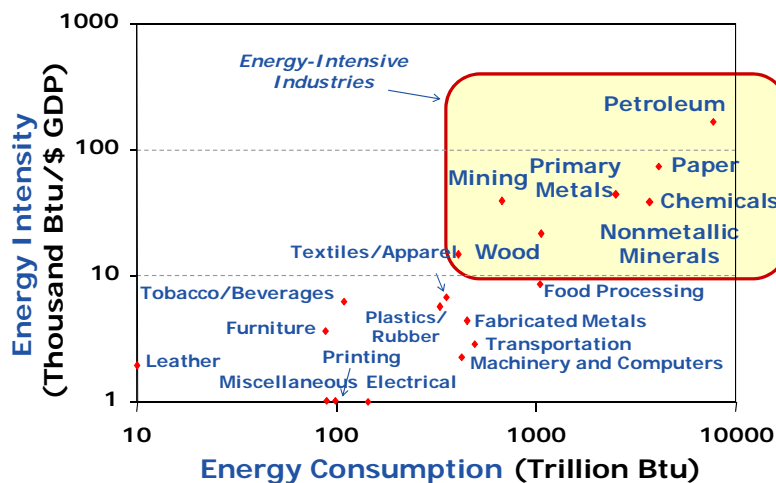
### Energy Efficiency is Part of the Equation

Process manufacturing assets also consume a tremendous amount of energy. Industry is the number one consumer of power, yet industry as a whole has a remarkably poor sense of how much power is being used at different times across manufacturing processes. Even in an environment of falling oil prices, power prices continue to rise. Many potential cost-saving opportunities related to power and energy consumption are ignored simply because people don't have the appropriate visibility or control. According to the US Department of Energy, industry accounts for about a third of all

energy used in the US. The most energy-intensive industries also just happen to be the process industries, including oil and gas, refining, pulp and paper, chemicals, and metals and mining.

Prolonged asset life and reduced greenhouse gas emissions are just two side effects of a good energy management strategy. Frequently, increased efficiency also means increased safety as well. You can see how an asset management strategy rooted in energy efficiency can provide the over-

### Industrial Energy Intensity vs. Energy Consumption



Source: US Department of Energy

**The Heavy Process Industries Consume the Most Energy and are the Most Energy Intensive of all Manufacturing (Source: EIA)**

whelming value proposition mentioned earlier, which cuts across multiple areas of the plant and provides a quick and substantial economic return.

ARC believes that ten percent of overall energy consumption in the process industries can easily be saved just by implementing a sound energy management program. Unfortunately, most end users lack many of the basic elements required to effectively measure and optimize energy consumption. In many cases, the correct work practices and tools are not available to allow end users to control energy consumption more efficiently.

## VigilantPlant Services Provide a Solutions-Based Approach to Operations

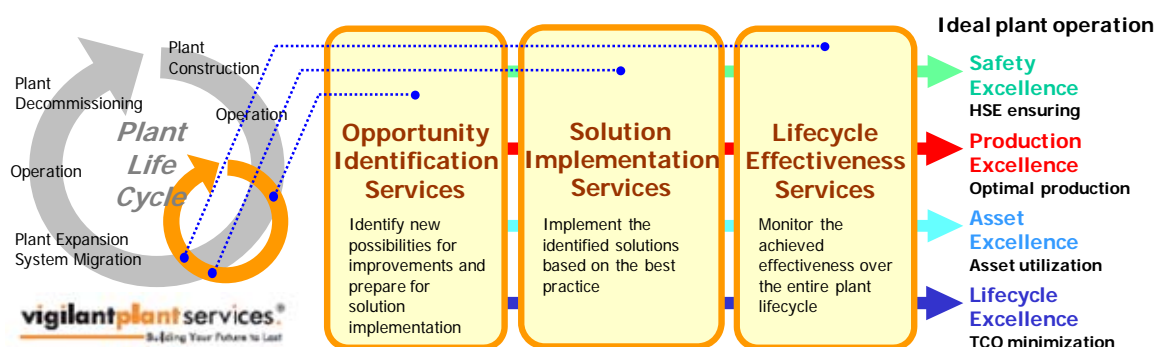
Yokogawa identified the need for a solutions based business that targets the operational phase of the plant as well as key plant assets. This was the thought process behind the creation of its VigilantPlant Services business. This was by no means a new business for Yokogawa. As a Japanese sup-

plier, the company was expected to provide a high degree of operational services around its products and applications for many years by its Japanese clients. High levels of operational service support are expected in the Japanese market, and Yokogawa has a 40-year history of providing operational services to most of the major owner operators in the refining, chemical, oil and other industries.

As part of Yokogawa's VigilantPlant strategic initiative, VigilantPlant Services consider the current state and scope of each end user's continuous improvement program. VigilantPlant's overarching message is to see clearly, know in advance what problems and issues need to be addressed, and act with agility to make fast and intelligent decisions.

### Not Just Services

VigilantPlant Services are more than just services –they are a suite of packaged solutions aimed at supporting manufacturers in their continuous improvement activities throughout the plant lifecycle. VigilantPlant Services follow this same model with three basic services-related domains: Opportunity Identification, Solution Implementation, and Lifecycle Effectiveness. Yokogawa's Opportunity Identification Services target new possibilities for operational effectiveness and improvement and help the end user prepare for the improvement project by providing a deeper understanding of plant performance in several key areas.



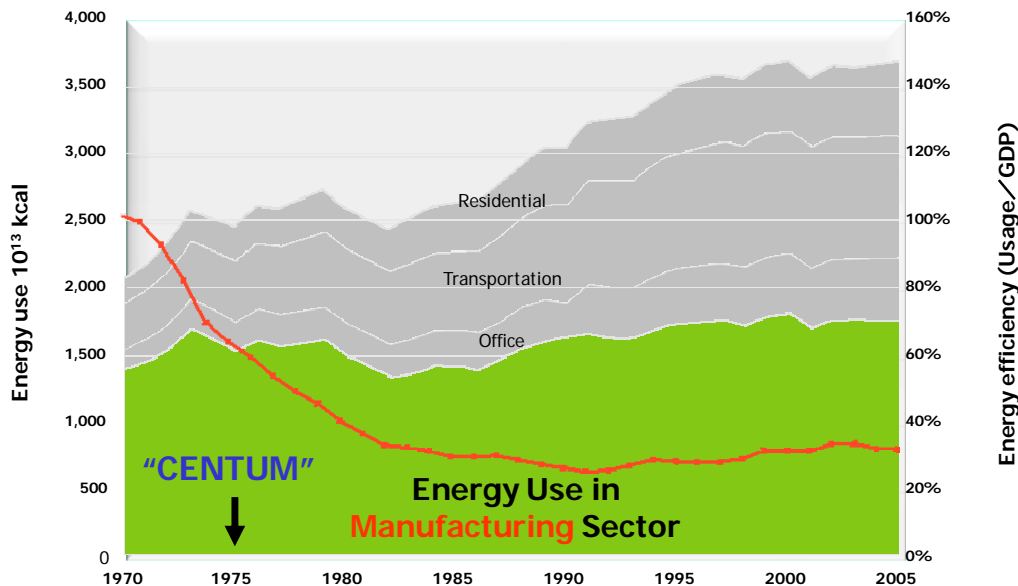
#### VigilantPlant Services' Three Introductory Steps

Solution Implementation Services are the next logical step in the chain after Opportunity Identification Services. With Solution Implementation, Yokogawa works with the end user to implement the solutions identified in the Opportunity Identification process, while working with internal experts developed under the Improvement Leader Development programs. Yokogawa's VigilantPlant Services engineers act as facilitators of an end user's

cross-functional team that identifies the root causes of a problem and its countermeasures.

Lifecycle Effectiveness Services make sure that the solutions implemented by Yokogawa continue to provide value throughout the plant lifecycle. So-

lutions can be implemented, but if not continuously maintained and reevaluated, they lose their effectiveness. This is particularly true for more complex solutions like advanced control and optimization, alarm management, and loop tuning. In advanced process control (APC) applications, for example, maintaining controller performance is



**Energy Use in Manufacturing was Greatly Reduced in the Wake of the Japanese Oil Crises, Remaining Flat for the Past 30 Years**

often more difficult than the initial setup, but is the key to sustaining long-term benefits. The performance of an APC application deteriorates over time due to equipment degradation as well as deliberate or unintentional changes in the operations of the process.

### VigilantPlant Services Focus on Sustainability through Efficiency

Increased energy efficiency and reduced environmental impact are cornerstones of Yokogawa's VigilantPlant Services philosophy. Again, this is where Yokogawa's heritage as a Japanese supplier provides it with some valuable perspective. The CENTUM DCS was born in 1975, right at the height of the Japanese oil crisis. Most process automation end users in Japan initially installed CENTUM in parallel with aggressive energy efficiency programs that drastically reduced the amount of energy consumed by Japanese manufacturers. By law, Japanese manufacturers must achieve 1 percent energy efficiency rates every year. Year over year, these



small incremental improvements in energy efficiency add up. This is why the energy consumption of industry in Japan is roughly the same as it was 40 years ago, despite the large amount of economic growth that has occurred in that time frame.

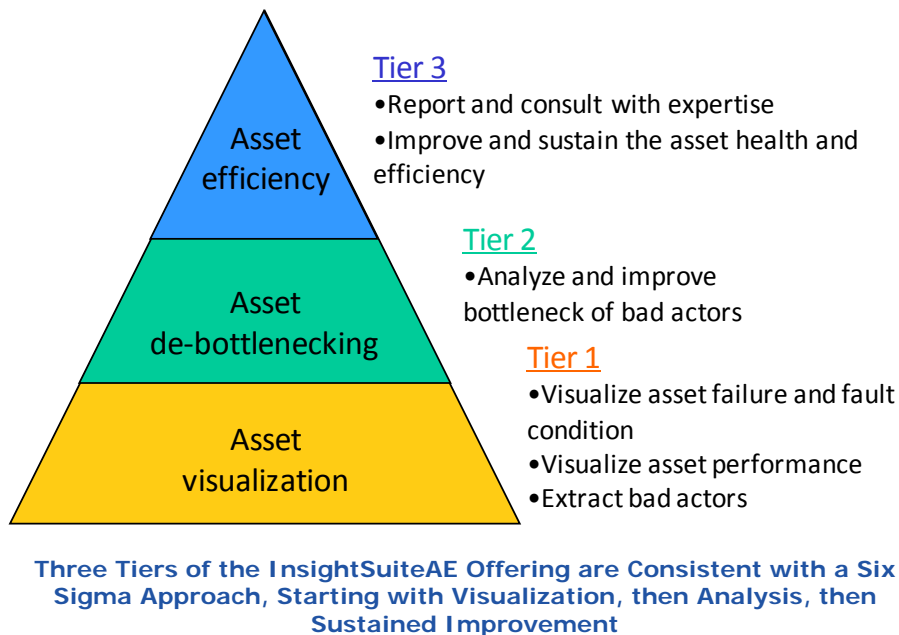
## InsightSuiteAE Uses Diagnostics to Optimize Plant Performance and OEE

InsightSuiteAE is a great example of how Yokogawa combines its product, application, and services expertise to create a solution that has a strong economic value proposition. While Yokogawa has many solutions aimed at the plant asset management space (PAM), such as Plant Resource Manager

(PRM) and Field-Mate™,

InsightSuiteAE

represents a quantum leap forward for Yokogawa in terms of using advanced diagnostic data and technologies to optimize the performance of plant assets and achieve the best possible Overall Equipment Effectiveness (OEE).



From digital field instruments to control valves, heat exchangers, and rotating equipment, InsightSuiteAE combines Yokogawa's applications, products, and services to balance operations and maintenance cost reductions with asset availability and performance improvements.

InsightSuiteAE is based on a three-tiered approach. The first tier is visualization of asset failure and fault condition, where Yokogawa assists end users in visualizing the performance of their assets and in identifying and extracting the bad actors. Tier two focuses on analysis and improvement of assets that are key bottlenecks, while tier three involves more advanced

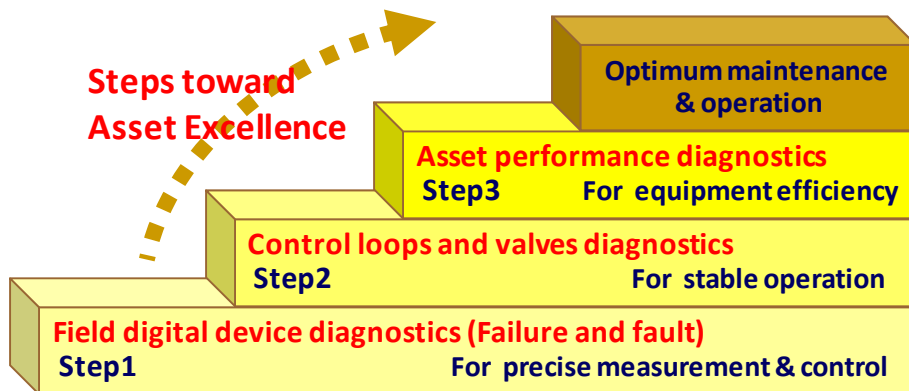
consulting services designed around continuous improvement and sustaining long-term asset health and efficiency. The three tiered approach is balanced by a three step phased implementation that is consistent with Yokogawa's VigilantPlant philosophy of seeing clearly, knowing in advance, and acting with agility.

### Visualizing Asset Performance

The first implementation step of InsightSuiteAE is Visualizing Asset Performance, which essentially boils down to the most precise measurement and control that can be achieved both through sensing technology and digital field device diagnostics that enable failure and fault detection. The visualization phase involves implementation of an improved maintenance strategy that balances reactive and preventative maintenance with predic-

tive and proactive techniques. Relevant information from instrument diagnostics is presented both to the DCS operator and to maintenance personnel through the PAM system.

The InsightSuiteAE diagnostics system takes information from PAM systems and digital field instruments and calculates KPIs such as avail-



**Three Steps of InsightSuiteAE Implementation with the Goal of Optimum Plant Maintenance and Operation**

ability, performance, and fault and failure status that makes it possible to develop a predictive and proactive maintenance strategy. The diagnostics system in InsightSuiteAE provides birds-eye view of entire plant assets, first level alarms, and can serve as a day-to-day operations and maintenance tool. InsightSuiteAE generates KPI reports that summarize all asset conditions and attach a health ranking. Reports can automatically be generated daily, weekly, monthly, or yearly as needed. One of the key KPI reports is "Field Digital Asset Diagnostics", which shows any recommended proactive maintenance tasks required or scheduled preventative maintenance. The report includes problem summaries and detailed problem areas by device.

## Control Loop and Valve Diagnostics

The implementation of control loop and valve diagnostics is the second step in InsightSuiteAE implementation. InsightSuiteAE's loop tuning simulator helps identify the best tuning parameters for the stable operation. ARC has isolated loop tuning as a subsegment of operational services because many suppliers are focusing on, and deriving growth from loop tuning and diagnostics. Suppliers now offer the ability both to identify loops that have the greatest impact on system performance and to diagnose and optimize these loops.

Control loop monitoring and tuning is also one of the most cost-effective ways to improve energy efficiency. Loop performance monitoring techniques are used to analyze the dynamic response of all control loops within a plant, including those associated with energy management, and identify and prioritize problems. Problems can range from poorly tuned loops to

control valve stiction, process disturbances, and loop interactions.



**Control Loop and Valve Diagnostics Offered by InsightSuiteAE**

Valve sizing and performance is important to ensure effective control. This is particularly important for energy-intensive operations, such as compressor anti-surge control. Valves have long been the most

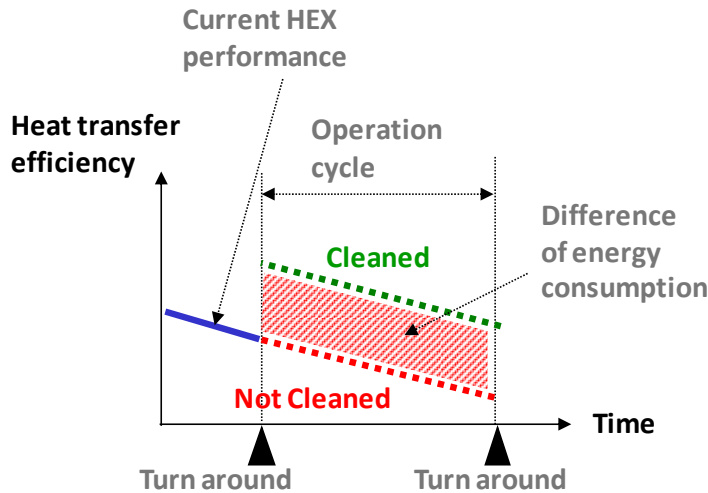
notorious plant automation equipment in terms of high maintenance cost and operating well below their optimal operation capabilities. The high cost of digital positioners and the impression that valves are simply “dumb iron” have all contributed to the limited adoption of control valves in many asset management initiatives. In addition, due to the highly specialized nature of valve operation, many “off the shelf” asset management solutions do not offer much in the way of operational benchmarking and root cause analysis for valves.

## Asset Performance Diagnostics: the Road to Smart Production Assets

When basic process controls are optimized through field device, loop, and valve diagnostics, it is then possible to target specific units or pieces of equipment in the plant and increase their overall performance and the overall performance of the plant. This is the third step of InsightSuiteAE implementation. Production assets are typically “dumb”, without a lot of

diagnostic capability or predictive capacity for impending failure, but InsightSuiteAE provides a predictive and proactive solution for many production assets. In this regard, InsightSuiteAE addresses many types of plant equipment including heat exchangers, rotating equipment and cracking furnaces.

Let’s use heat exchanger diagnostics as an example of what InsightSuiteAE can do for plant equipment. Heat exchangers consume large amounts of energy in the plant and the fouling of heat exchanger shells and tubes can greatly

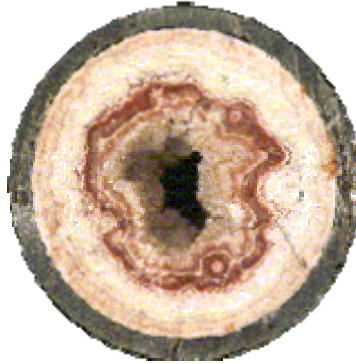


**Identifying Which Heat Exchangers are Fouled Can Result in Significantly Increased Energy Efficiency**

degrade heat transfer efficiency, so many heat exchangers end up consuming more energy than they are rated for. Heat exchangers are also frequently the cause of plant incidents, especially during startup. At least one of the major process plant incidents in North America in the past year was due to a faulty heat exchanger, and these incidents can be prevented with the implementation of heat exchanger diagnostics.

InsightSuiteAE heat exchanger diagnostics measure heat performance such as heat transfer efficiency, fouling rates, and so on. Many plants have no heat performance monitoring tools installed for their heat exchangers. This was the case with one end user customer that Yokogawa worked with. The customer was using time-based maintenance to deal with heat transfer fouling. Cleaning of heat exchangers needs to be judged by keeping a balance between lost production and the maintenance cost. Without real time performance monitoring in place, however, the decision can often be a difficult one.

By implementing InsightSuiteAE heat exchanger diagnostics, the end user was able to take advantage of predictive diagnostic to allow identification of bad acting heat exchangers, and they were able to save money through reduced pumping power and increased heating efficiency. Based on the real time measurements from the hundreds of heat exchangers in the plant, the end user was able to calculate future performance through the In-



**Cross Section of a Fouled Heat Exchanger Tube**

sightSuiteAE Prediction Diagnostics. Using this data, the exchangers that were operating inefficiently were able to be identified for cleaning during the next turn-around so that maximum energy savings could be achieved.

There were significant savings achieved by the end user by implementing InsightSuiteAE. The early extraction of large energy losing exchangers resulted in significant energy savings. Exchanger feed pumps experienced significant en-

ergy savings as well because fouling was identified and removed from the proper exchangers. Operational cost savings were also achieved through improved efficiency of heat transfer.

### **The Final Step – Optimized Maintenance and Operation**

The ultimate goal of InsightSuiteAE is to provide the end user with optimized plant maintenance and operations. By taking a bottom up approach that starts with intelligent field devices, InsightSuiteAE is able to provide solid proactive diagnostics all the way up to key plant assets such as heat exchangers, rotating equipment, and cracking furnaces. InsightSuite also provides high resolution of key performance indicators. An end user may know there is a problem through measuring KPIs like overall equipment effectiveness, but they may not know how to solve that problem. InsightSuiteAE provides the vital link that users need to go beyond the diagnostic aspect of what is going on in plant equipment to address and solve the problem proactively.

However, implementation of InsightSuiteAE can result in a lot more than a better maintenance strategy and improved OEE and asset utilization. As we saw in the heat exchanger case study, significant energy savings can be obtained when you have a real time view into what is happening in plant equipment and automation assets. It is much easier to justify purchases of automation based on significant energy savings instead of reduced mainte-

nance costs. The technology of InsightSuiteAE can also be applied to quality management purposes and can actually provide a platform for predicting quality. It can also be used to improve individual operator performance.

## **CombustionONE: A Step Change in Process Heating**

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InsightSuite is a good example of an automation solution that provides the overwhelming value proposition that we spoke of earlier – one that cuts across multiple disciplines of reduced energy cost, increased quality, im-



**Process Heaters like This One  
Consume Significant Energy and  
Pose Inherent Risks**

proved asset utilization, and so on. CombustionONE is another new solution from Yokogawa that builds on this same concept of the overwhelming value proposition, with impact that is hard to ignore for fired heaters, which are the biggest energy consumer in the process industries, to just about all combustion processes.

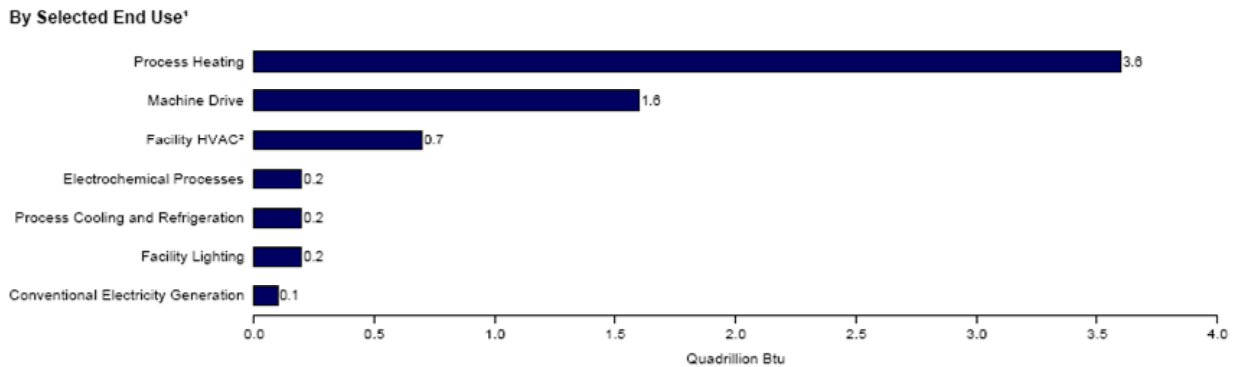
With a combustion process, the dynamics of what is happening in the physical asset are just as important as the control aspect. Consistent with the Vigilant-Plant Services philosophy, CombustionONE combines Yokogawa's products, applications, and services expertise to provide a total solution for real time measurement of efficiency of combustion related processes. The services component is especially important with CombustionONE, which includes installation services, commissioning services, and ongoing maintenance and support services for asset sustainability.

### **The Problem with Fired Heaters and Combustion Processes**

Today, there are over 7,000 fired heaters installed in US refineries and petrochemical plants alone. They are one of the most ubiquitous, yet one of the most under-optimized assets in all of process automation. CombustionONE addresses four core areas related to process heating -- increased



safety, reduced energy costs, reduced emissions, and reduced operating costs.



**Process Heating Dominates Total Consumption of Energy in Manufacturing in the US**  
(Source: EIA)

### Process Heating Brings Inherent Safety Risks

The operation of fired heaters involves inherent risk. Explosion in the firing space and rupturing of tubes are primary hazards of fired heaters. Many explosions in the firing space take place during procedures such as plant startup, when combustible vapors are allowed to build up in the firing space and may leak into other parts of the plant. Incidents also happen during maintenance procedures.

### Reduced Energy Cost Opportunities

Fired heaters are the number one consumer of energy in the process industries. Most process heaters are gas fired units, and these represent the largest consumers of natural gas in the process industries. A dynamic energy market in which energy prices can change several times a day also makes managing energy costs more complex.

Most fired heaters are run with natural draft air, in other words, they use the air from their own surroundings and no additional air is forced into the heater. Because there is very little air control using this method, operators will often allow excess air into the heater, thus reducing thermal efficiency.

Even if you can lower energy consumption for fired heaters by 5 percent, you are making a huge impact on overall energy consumption. Back in 2001, the US Department of Energy did a report on potential efficiencies that can be realized from process heaters, and the potential savings are sig-

nificant, even with the process automation technology available ten years ago.

### Process Heating is a Huge Source of Emissions and Regulatory Concerns

Clearly, energy costs can be a significant portion of a manufacturer's overall cost, and have a big (and growing) impact on profitability. Looming, however, is a change in how carbon dioxide and other emissions are regulated. While regulations or mandates are still in flux, it is certain that along with energy, carbon and other emissions will have to be treated as a cost of production and manufacturers will have to maintain the delicate balance of energy costs and emissions costs when making decisions about production and energy sources.

Process Heating Component	Energy Saving Method	Energy Saving Potential (% of Current Use)	Typical Implementation Period	Typical Payback
Heating Generation	Efficient combustion (burners) and operation of other heat generating equipment	5%-25%	1 Week to Two Months	1 to 6 Months
Sensors and Controls	Improve Process, Measurements, Controls, and Process Equipment	5%-10%	1 to 10 Weeks	1 to 6 Months
Process Models and Tools	Process Models and Simulation to Optimize Equipment Design and Operations	5%-10%	2 Weeks to Six Months	1 Month to Two Years

**Significant Energy Saving Methods for Process Heating and their Payback Times**  
(Source: US DOE)

### API Recommended Practice 556 Adds to Regulatory Compliance Needs

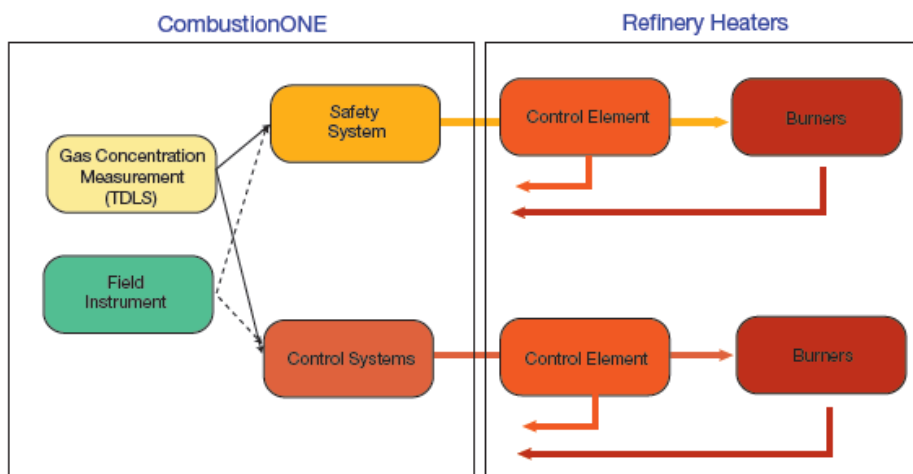
Emissions regulations aside, there are several other sets of regulatory requirements that end users must comply with relative to process heating. Published by the American Petroleum Institute, API Recommended Practice 556 outlines recommended practice for "Instrumentation, Control, and Protective Systems for Gas Fired Heaters". The document is designed to provide safer and more efficient operation of fired heaters in these facilities,



which are often the source of unplanned downtime and incidents in the process industries. Covered under the practices are the primary measuring and actuating instruments, controls, alarms, and protective systems as they apply to fired heaters. Most of the natural draft heaters installed in refineries and petrochemical plants today do not meet the requirements of existing instrumentation and manual control of air volume. API 556 will be completed soon.

### Improving Return on Assets and Lowering Cost of Ownership

Return on assets and lifecycle cost are key issues affecting automation end users today. Manufacturing's current challenge lies in improving Return on Assets (ROA). In other words, the challenge is to utilize manufacturing assets more profitably and effectively. This perspective is most critical in the process industries because manufacturing assets are a dominant component and their maintenance costs are so high. The challenge is punctuated by the fact that process manufacturers' ROA, the measure of performance the financial community uses for process companies, does not equal the cost of capital. Many end users are also experiencing increased maintenance costs relative to their process heaters, and the current labor



### Primary Elements of CombustionONE as they Relate to Process Heating

time provide a 100 percent payback on the investment in a relatively short period of time, in many cases between one and six months. At the same time, however, safety is increased, overall emissions are reduced, and efficiency is improved. It is a perfect example of the "overwhelming value proposition" that is required in today's business environment to justify investment in automation.

crisis in the process industries means there are fewer resources to take care of a greater scope of equipment and assets in the plant.

The key aspect of optimizing fired heaters is that the energy cost reductions, reduced maintenance costs, and reduced down-

## Yokogawa Combines Instruments, Systems, and Services Expertise to Create a Fired Heater Solution

CombustionONE is not a product. As part of VigilantPlant Services, CombustionONE combines instruments, systems, applications, and services expertise to create a solution for fired heaters and combustion applications. The combination of hardware, software, and services can be implemented

in varying degrees to create a solution for an end user's specific fired heater requirements.



### Yokogawa Tunable Diode Laser Analytical Technology

The first stage of CombustionONE involves the service capabilities of both Yokogawa and its partners, who audit and inspect the combustion related assets at the end user site to determine what is required. This

site analysis is vital, especially since many refineries and process plants have their own safety standards that they must comply with in addition to other safety and environmental regulations. Fired heaters all have their own unique profile, so each must be evaluated in terms of any specific problems or issues experienced with that asset as well as the overall profile of that particular asset. After the site requirements are assessed and determined, Yokogawa then implements the solution using its arsenal of instrumentation, analyzers, process safety systems, process automation systems, applications, and any additional services that may be required.

But that doesn't mean the end user has to do a "big bang" implementation of CombustionONE on all of its fired heaters. In many cases, Yokogawa will come in with just three people and audit three heaters, and then pick the one that is most in need of optimization. CombustionONE is also not limited to fired heaters. Yokogawa plans to expand the program to include all combustion related processes and plant steam systems.

### **Instrumentation Provides Real Time Data Around the Combustion Process**

Historically, there have been few options for instrumentation and control systems that can effectively measure fuel concentrations and fuel/air ratios. Yokogawa offers a full range of intelligent instrumentation including multivariable pressure transmitters and valve positioners to provide accurate measurements on and around the heater. Yokogawa safety transmitters can be added to a CombustionONE solution to provide additional instrument as needed for airflow measurements at multiple locations on the fired heater.

### **Tunable Diode Laser Provides Real Time Measurement of Combustion Gases**

The harsh operating conditions associated with combustion analysis applications can eat up a sensor in no time, resulting in inaccurate and unreliable sensor measurements. This can make it nearly impossible to control these processes adequately. Yokogawa has turned their attention to this problem. The real time measurement of combustion gases such as CO and O<sub>2</sub> has recently been made possible with the introduction of its Tunable Diode Laser Spectroscopy (TDLS) solution.

Historically, obtaining reliable quality measurements in time to improve control has been an issue in combustion control applications. The current best practice utilizes a Zirconia sensor for point measurement of oxygen. In applications requiring multiple measurements, point measurement cannot provide a representative sample, making it both error-prone and potentially dangerous. Process oxygen measurement requires samples to be extracted and then transported to an analyzer for conditioning and analysis. This slows response time, adds cost, and degrades measurement accuracy.

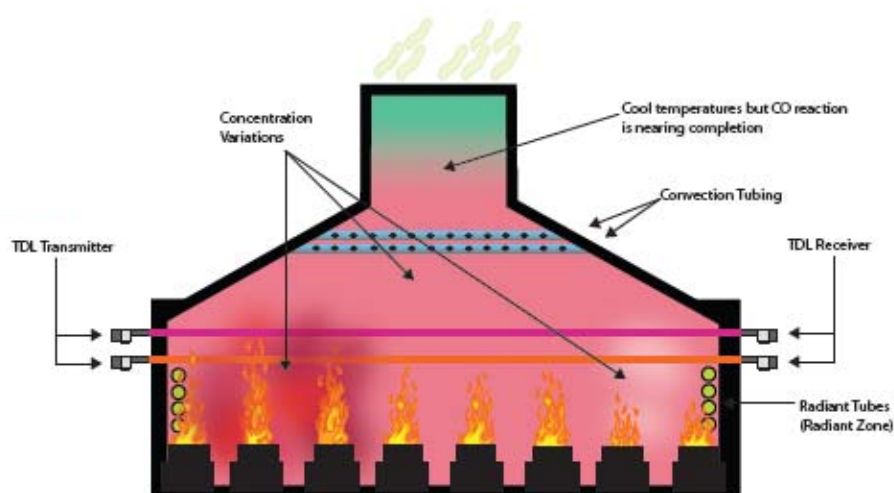
Inefficient combustion can be attributed to the air/fuel ratio. Too much excess air (air rich) results in loss of efficiency and increased NO<sub>x</sub> emissions, while too little excess air (fuel rich) is downright dangerous. Carbon monoxide measurement provides an indication of fuel-rich conditions, while oxygen measurement indicates air-rich conditions. The optimum control point is the lowest possible excess air value that does not cause the system to enter into an unsafe condition or violate emissions limits.

Feature	Benefit
In-situ analysis	Sample conditioning not required
Fast response	Real-time data for APC
Tunable laser	Interference-free analysis
Non-contact sensor	Suitable for operation in harsh environments
Optical sensor	Low maintenance

### Features and Benefits of TDL Technology

Tunable diode laser technology is an innovative measurement technique that utilizes semiconductor lasers to detect a variety of gases at trace levels in the part-per-million (ppm) or part-per-billion (ppb) range. Tunable lasers, which enable miniaturization of transmission and receiving units, provide highly sensitive, quantitative measurements with fast response times without the need for recalibration. The lasers can be tuned to detect specific constituents independent of process gas concentrations.

Yokogawa's TruePeak Tunable Diode Laser Gas Analyzers use the TDL technology, which works by absorbing infrared light at wavelengths specific to each individual gas.



### Yokogawa TDL Technology Enables Measurement of Combustion Gases in the Combustion Zone

Specific gas concentrations can be measured by illuminating them with a laser and analyzing the absorbed wavelength in the spectrum of the transmitted light. TDL technology can be implemented to measure combustion gases in or near the combustion zone, and allow the formation of a measurement grid to optimize important furnace control variables, such as excess air and bridgwall temperature. Rapid BTU measurement of fuels allows feed-forward control of fuel and reduces coil outlet temperature variability. This will help distribute fuel to furnaces more efficiently. The ultimate objective is to

optimize important furnace control variables, such as excess air and bridgwall temperature. Rapid BTU measurement of fuels allows feed-forward control of fuel and reduces coil outlet temperature variability. This will help distribute fuel to furnaces more efficiently. The ultimate objective is to

integrate advanced combustion and fuel measurements into a process control strategy for furnace optimization.

Quick analyzer response is key to preventing explosions. If you want to conform to the standard, you have to put measuring systems down in the radiant section of the fired heater. The only sensor that can survive in such an environment is a TDLS.

### Process Control and the Combustion Interface Unit

Process control is an essential part of the CombustionONE solution. Yokogawa, however, does not mandate the use of their own control system in the CombustionONE framework, and will work with other DCSs. Data from third party process automation systems is easily accessed via OPC and standard Ethernet control networks.

Yokogawa, however, does offer its own controllers to provide standalone capability for controlling fuel flow and air volumes based on five-second sampling measurements of gas concentrations from the TDLS system. A dedicated controller is programmed with fired heater combustion control strategies. This Combustion Interface Unit (CIU) has its own local historian, which can also interface with third party historians. The CIU consists of a



**The CombustionONE  
Combustion Interface Unit (CIU)**

cabinet and local built in display that can trend the TDLS data, host startup and shutdown operating procedures, and interface with the combustion control and safety system. The CIU can be located anywhere in the field and is housed in a NEMA 4X cabinet for Class 1 Div 2 areas.

### CombustionONE Provides Enhanced Process Safety

Yokogawa's ProSafeRS process safety system meets OSH, ISA 84, IEC 61508, and other standards for safety on process heaters. Aside from the process safety system, Yokogawa also has safety instruments that can provide several additional safety benefits through implementation of CombustionONE. The Tunable Diode Laser system can detect fuel rich conditions inside the heater with a response time of five seconds or less.

CombustionONE also offers a safety trip for prevention of tube coke-up. Most fired heaters are sensitive to the uneven distribution of process flow among heater passes. Once uneven distribution starts, it must be corrected.

Yokogawa can reroute the existing wiring for flow transmitters to the safety system for trip logic. When low pass flow is detected, the trip logic will trip the fuel shutoff valve to prevent tubes from overheating and tube coke up due to lack of flow in one of the heater tubes.

### **Applications and Automating Standard Operating Procedures**

CombustionONE can include a wide range of applications from the embedded historian in the Combustion Interface Unit to human interface software. One area where Yokogawa stands out, however, is in procedural automation with its Modular Procedural Automation (MPA) application. MPA can be incorporated into CombustionONE to provide safe start up and shutdown using standard operating procedures. Using MPA, the operator can perform a series of leak tests and run a series of sequences as part of the startup or shutdown procedure to prevent an unsafe condition. Tests and sequences include pre purge testing, warm up purge steam line testing, purge sequences, and pilot and main burner ignition sequences.

### **Ongoing Operational Services are a Key Component**

Services are a big component of the CombustionONE solution. Since CombustionONE is part of VigilantPlant Services, there is a philosophy of continuous improvement, and Yokogawa can offer continuous remote monitoring services and other ongoing operational services as part of the solution.

### **No Downtime Required for Installation**

Downtime is a primary enemy of the process industries. The time between maintenance turnarounds in the hydrocarbon processing industry, for example, has been increased to around five to seven years. In the future, turnarounds will be stretched to every ten years or more. CombustionONE requires no downtime for installation. The holes and plates required for the installation of TDLS systems can be cut while the unit is hot.

## **Conclusions & Recommendations**

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VigilantPlant Services have taken a major strategic shift to focus more on specific assets in process plants and to solving some of the persistent problems associated with them. In ARC's opinion, Yokogawa is building on the strong "overwhelming" value proposition that is required to make signifi-

cant investments in automation today – one that provides significant energy cost reductions, improved safety, improved regulatory compliance, and lower operating and maintenance costs.

Selling solutions like InsightSuiteAE and CombustionONE takes a different approach than the traditional product-based sales approaches that have so dominated the automation business since its inception. The first step is to educate the customers about the problems that the solution addresses and how it addresses them. There has been a lot of debate in the industry as to what selling a “solution” really means, but in our view it means combining product expertise with applications and services capabilities to solve a business problem and to provide improved return on assets and return on investment. If this is the measure of a solution, then InsightSuiteAE and CombustionONE are excellent examples.

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**Acronym Reference:** For a complete list of industry acronyms, refer to our web page at [www.arcweb.com/Research/IndustryTerms/](http://www.arcweb.com/Research/IndustryTerms/)

<b>API</b>	American Petroleum Institute	<b>NFPA</b>	National Fire Protection Association
<b>B2B</b>	Business-to-Business	<b>OEE</b>	Overall Equipment Effectiveness
<b>BPM</b>	Business Process Management	<b>OpX</b>	Operational Excellence
<b>CAGR</b>	Compound Annual Growth Rate	<b>PAM</b>	Plant Asset Management
<b>CAS</b>	Collaborative Automation System	<b>PAS</b>	Process Automation System
<b>CIU</b>	Combustion Interface Unit	<b>PLC</b>	Programmable Logic Controller
<b>CPG</b>	Consumer Packaged Goods	<b>PLM</b>	Product Lifecycle Management
<b>CPM</b>	Collaborative Production Management	<b>RFID</b>	Radio Frequency Identification
<b>DCS</b>	Distributed Control System	<b>ROA</b>	Return on Assets
<b>HMI</b>	Human Machine Interface	<b>RPM</b>	Real-time Performance Management
<b>IT</b>	Information Technology	<b>SCM</b>	Supply Chain Management
<b>KPI</b>	Key Performance Indicator	<b>TDLS</b>	Tunable Diode Laser System
<b>MPA</b>	Modular Procedural Automation		

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