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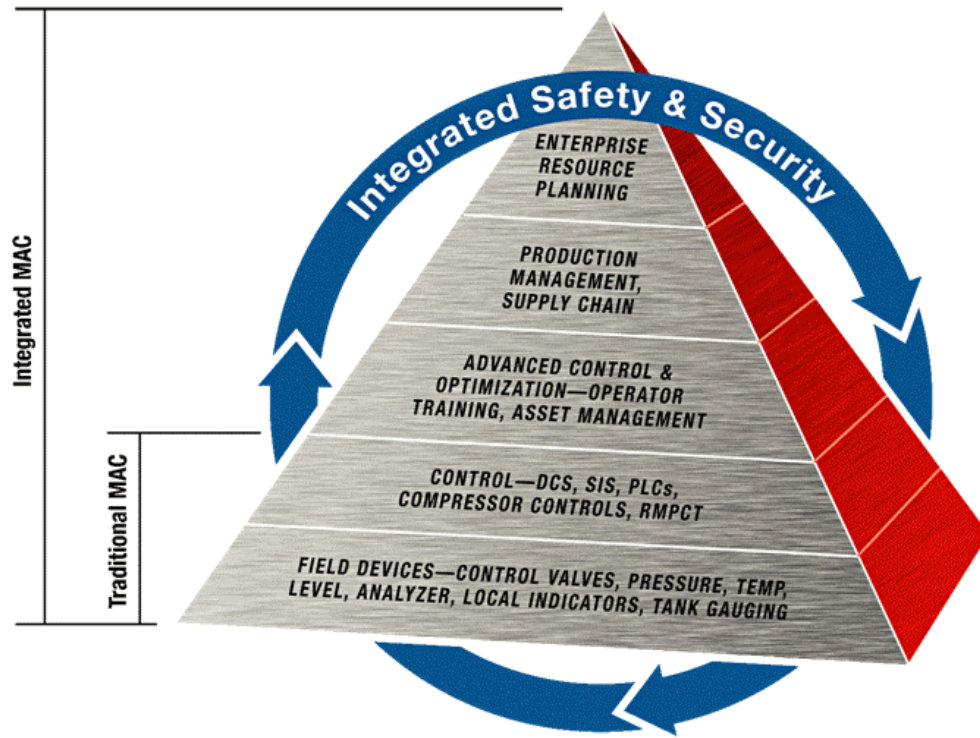
By ARC Advisory Group

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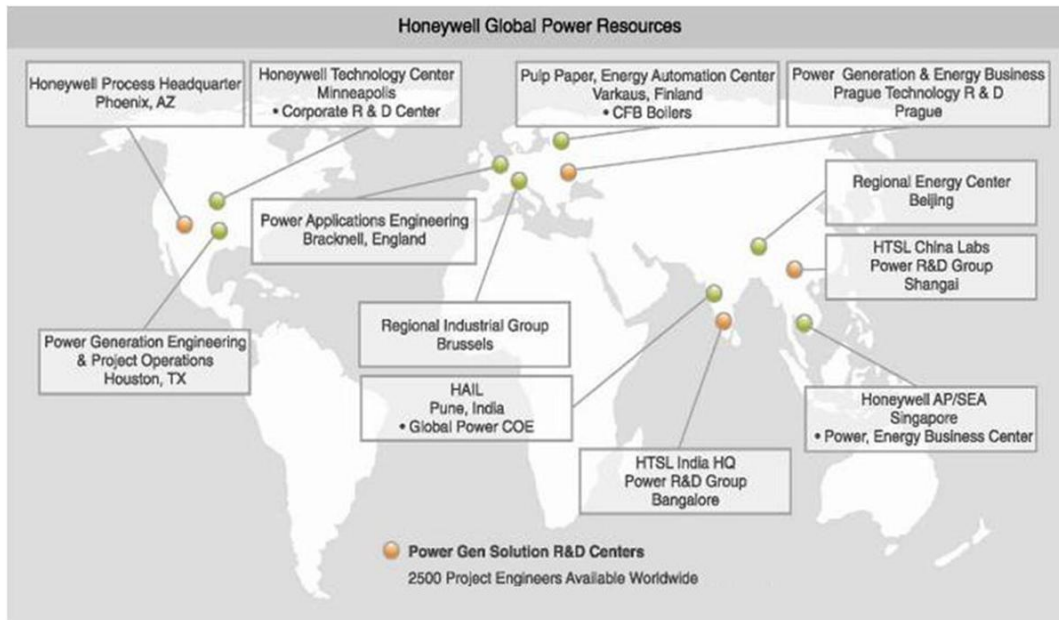
Honeywell in the Power Industry: Solutions for Today's Complex Market

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Honeywell Views Its Role as an Integrated Main Automation Contractor



Honeywell has Cultivated Global Resources to Serve Power Generation Projects

Executive Summary

The recent global financial crisis adds just one more difficulty to a host of other challenges that confront those charged with developing new power generation capacity or investing to support existing power stations. Environmental and business regulations, tight global markets, aging assets and workforces, increased threats to security, and changes in industry structure all loom, and have never been more pressing.

Honeywell has developed a culture of continuous improvement. This has globally harmonized its business processes for automation and integration in major capital projects. How can this corporate capability serve the increasingly complex needs of power generation projects?

Power plant developers have most often used automation supplied by their major equipment OEMs. Given the tightly coupled nature of a power plant, OEM equipment always plays some role. Honeywell is a global leader in the process automation space, but has no history as an OEM of power equipment. Honeywell's strategy to address power projects is to combine its long-standing culture of continuous improvement with its huge experience as an automation supplier and integrator for complex global capital projects.

Honeywell seeks the project role of an Integrated Main Automation Contractor, or I-MAC. This role allows Honeywell to draw on the capabilities of all its business units and on Honeywell's established technology and business partners. It also enables Honeywell's global organization to be deployed to support power customers regardless of their location. Years of work in the continuous improvement of Honeywell internal business processes (using Six-Sigma and other tools) has paid off for Honeywell in complex projects with major energy end users and service organizations. Honeywell believes this same capability will become more important for future power generation projects, which will also grow in complexity as utilities become less vertically integrated and project organizations become more complex.

In addition to this business methodology, Honeywell has used its culture of improvement to develop a full complement of technology products for its Experion system that address the specific needs of central station and industrial power generation operations. As it focuses on increasing its presence in the power market, Honeywell will further leverage synergies with its portfolio of industrial solutions.

A Critical Service

The global market for electric power generation and associated equipment is larger and more critical than ever before, but participants in today's market might well envy the greater stability this market enjoyed in decades past. Today's market for power generation is far more challenging.

This is not to say that power is unappreciated. Quite the contrary, today more than ever electric power is widely recognized as critical. In developing economies the growth of electric power infrastructure is fundamental both for economic development and to support the higher standards of living that economic development affords. It is not surprising that the world's largest developing economy, China, has also led the world for several years in the construction and commissioning of new power generating capacity. The rapidly growing Indian economy has also spurred much new power generation development, often in the form of "captive" power plants that serve new manufacturing plants. China and India today represent the high-growth segments of the global power market.

In developed economies the transition to more information-intensive workplaces and homes has made electric power ever more critical to both business and lifestyle. Electricity drives our corporate and personal IT infrastructures and commerce. Businesses that operate 24/7 need ever more reliable electric power and higher power quality to keep their information works operating reliably. While these new uses for electric power may not produce the rapid load growth of China's industrialization, these economies increasingly depend on the reliability and quality of electric power to drive the information and entertainment services that are fundamental to work and play in developed economies.

Facing Unprecedented Challenge

Power generation inevitably takes a long-term view, given that power plant infrastructure is long lived, immovable, and requires long-term plans for fuel supply and asset lifecycle management. But in today's economic climate business planning horizons have shrunk dramatically. This makes planning, operating, and maintaining power generation infrastructure far more difficult. A number of major factors are impacting power generation. While some of these are well known, others are quite new. But in terms of

the sheer number of major challenges arriving simultaneously, today's climate is simply without precedent. The largest of these challenges are:

- **Economic volatility** – The global financial crisis of 2007-08 hits power generation very hard, as this is the most capital-intensive of all industries. Availability of credit, both long term and short term is essential for the development and operation of power generation infrastructures. These assets take years to develop, and the chaos in financial markets adds new uncertainty to the planning and development of new generation capacity, as well as holding up major outlays for improvement of existing plants.
- **Integration of renewable primary energy** – Recent years have seen boom-style growth in renewable power generation, most particularly wind generation. The rapid growth of wind power in the EMEA region is now being mirrored as growth ramps up in North America and Asia. But integrating these new generators into the grid is more difficult than units using other types of primary energy. Wind generation is often located remotely, requiring extensive transmission. The inherently intermittent nature of wind power changes the way grid planning and operation of existing plants is performed. Similar challenges await as other new energy processes reach commercialization. For example the new IGCC “clean coal” plants also have radically different dynamics and far more complex operations than traditional fossil-fired generating units.
- **Tightening environmental standards** – New and more restrictive regulations for emissions are coming into view, which include so-called greenhouse gasses. This is likely in all markets, not just for signatories of the Kyoto Protocols. Such regulations are likely to include the emission of CO₂, and the development of markets for CO₂ emission trading. These regulations are already changing the economics of power generation operations. In North America, the prospect of these regulations has put many future plans for coal-fired central stations on indefinite hold.
- **Industry restructuring** – The traditional utility model is of a vertically integrated electric utility serving all aspects of the electric business within a geographically defined service area. Today that model is just one among many. While there have been many stops and starts in electric deregulation, electric utility companies cannot be certain that the present structure of their business will persist. In addition there is al-

ways pressure for business consolidation and achievement of economies of scale in utility operations.

- **Globalization** – Electric power remains a national or regional business, but the supply chains that support utility operations are now fully globalized. Resources such as fuel, major equipment, and services are provided by global firms who are able to deliver to whichever regions and markets are in need. For example, most US-made gas turbines were delivered to the domestic market in the power boom year of 2001. Five years later, the same dollar volume of US-made turbines was being delivered overwhelmingly to export customers. Power resources now seek out the global high bidder.
- **Aging assets** – The difficulty in developing new generating capacity and demand growth has left aging generating plants operating in many regions. Given today's financial climate, this will continue for some time, presenting utility companies with the challenge of operating an older and less productive plant in a more restrictive regulatory environment.
- **Aging workforces** – Physical assets are not the only ones to show signs of aging. The demographics of utility workforces dictate that a large fraction of those operating and maintaining electric infrastructure today will soon retire. Besides the obvious challenge of training new workers, utility companies need ways to build a culture of safety and environmental responsibility through widespread use of best practices, whether new or old.
- **Security for critical infrastructure** – The criticality of electric power service combined with its geographically dispersed infrastructure makes all types of security more important than ever. Power plants and critical T&D components represent critical infrastructure that must be protected from physical attacks and from network-based cyber threats. In the past these concerns were restricted to nuclear power operations. No longer.
- **Growing demand** – Through all these barriers to growth, utility customers continue to want more electricity, and want it with higher quality and greater reliability. While electric consumption in developed economies shows more modest 2-3% annual growth, developing economies grow their electric consumption at near double-digit annual rates.

Honeywell and Power Generation

While a global leader in process automation, Honeywell is usually not the first supplier that comes to mind when thinking about power plant automation. Most customers associate Honeywell first with automation in oil refining, oil & gas production, or chemical processing. While power generation employs the same types of automation equipment, automation in power generation is a very distinct specialty from these other industries.

Automating and managing a power generation station is markedly different from automation in other process industries. Power plant automation involves the tight integration of a few pieces of critical equipment (boiler,

The unique characteristics of power generation plants make their automation and integration distinct from other industrial processes, even though much of the same type of equipment is used.

turbine, generator, major auxiliaries). This equipment can experience very rapid dynamics compared to other process industries. Unlike many processes which consist of hundreds of single control loops, the power generation process is unitized, and the unit is either online or offline as a whole. Thus the whole automation system also must operate as a tightly coupled unit. Power equipment is designed to operate close to its engineering limits, especially large turbines.

As a result, turbine OEMs invariably supply the automation systems for their own machines. Because of this, the suppliers of OEM equipment (or their corporate successors) enjoy a large fraction of the power plant automation business, and they represent the names most often associated with power plant automation.

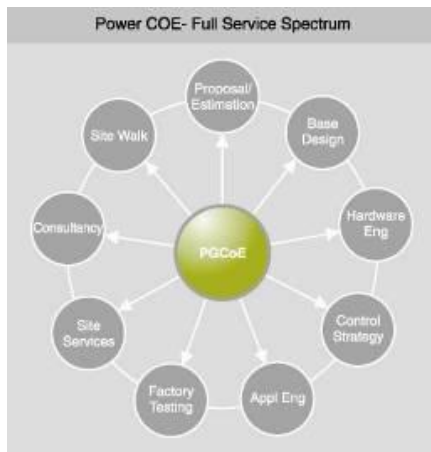
Yet Honeywell has built itself a solid place in this market for power automation systems without any history as an OEM of power equipment. Why do end users choose Honeywell, especially when they could choose one of their OEMs for roughly the same automation functionality? Perhaps the main reason is that Honeywell's broader experience in process automation has allowed the company to develop business practices that translate well into the power generation application. Automation supplier differentiation is much more than a question of technology. It is the business and technical practices of an automation supplier that are key success factors for consistently meeting rising customer expectations. Honeywell has developed and maintains consistent business and project practices with its customers in all vertical industries. Honeywell's bet is that over time this consistency will pay dividends in the power industry as well.

An Integrated Main Automation Contractor (I-MAC)

Modern development and construction projects for power and process manufacturing have grown in complexity. End users of new plants must manage this complexity and the globalization of suppliers and resources. Owners must manage the project to meet important business objectives. Project success is defined as:

- Project Milestones - Keeping the project on-budget, on-schedule, and controlling risk
- Operations and business readiness - On-time unit start up, smooth unit commercialization, and reliable 1st year operations
- Business sustainability - asset safety, reliability, and efficiency from concept through the full operating life of the unit (often 40+ years)

Meeting these objectives requires teamwork among many organizations. The plant owner and architect/engineer (A/E) are doubtless the leaders of this effort. Major equipment OEMs also play a big role. Honeywell defines



its role as an “Integrated Main Automation Contractor” or I-MAC. In this role Honeywell does more than bring its own products and services to the project. Honeywell acts as a coordinator for many automation-related parts of the project that are critical for meeting the above business objectives. Honeywell does this by drawing on Honeywell business units and on established partnerships with global suppliers. I-MAC projects also involve the formation of integrated teams from Honeywell, the A/E, the owner, and others. Examples of work performed in this I-MAC role are:

- Management of an integrated plant simulation capability for plant design, operator training, automation testing, and optimization applications
- Management of OneWireless mobile business applications for best practices in operations, maintenance, equipment condition monitoring, startup and outage management (by Honeywell and partners such as SAP, IBM, and others)

- Integrating the automation and field equipment with the owners ERP applications and doing so with safety and security

The role of the traditional Main Automation Contractor (MAC) has become critical in many global energy development projects. By expanding this role to an I-MAC approach and extending this concept to power generation projects, Honeywell is able to leverage its deep experience in large capital projects for process manufacturing in power generation. Over the past decade, Honeywell has worked with major global engineering service firms to develop and refine this capability. This has given engineering firms practical experience with this project structure through a large number of global energy development projects.

Another advantage Honeywell harvests from its experience is a strong focus on its own project engineering and management processes. This focus is part of the overall program of continuous improvement within Honeywell. Over time, Honeywell Process Solutions has used this program to refine and document its own project engineering processes. Clearly this helps to communicate its work processes within its own regional engineering centers, but these definitions also add clarity to outside project relationships and help EPCs and owners to most effectively use Honeywell's I-MAC capability.

An additional reason for the emphasis on continuous improvement within Honeywell is the need to deliver consistent project implementations globally. As the company has expanded its engineering centers beyond North America and Europe to Asia, the expansion has benefitted from company initiatives in continuous improvement. Today Honeywell has five major power and energy operation centers in the growing power markets of Asia. Continuous improvement and uniform business processes enable the resources of these newer organizations to support Honeywell projects worldwide. Honeywell's engineering organizations include over 2500 engineers throughout its global centers, and many are dedicated exclusively to power generation projects.

Honeywell has worked to unify and improve its own business processes in order to deliver consistent quality to its automation customers, regardless of their vertical industry. This positions the company's power generation teams to benefit from the experience of a much larger organization. The automation organizations of power equipment OEMs have difficulty matching this broad capability.

Technology Solutions for Power

Business process aside, automation of power generation requires a set of very specific engineering and product capabilities. What does Honeywell have to offer here? The company uses its flagship Experion automation platform for all its power deliverables. But beyond an automation platform, Honeywell has developed a specific set of solutions that it uses to build projects for power generation. These integrated solutions include:

- Power-specific capabilities within Experion
- Turbine Control
- Burner Management System functionality
- Fire and Gas Detection
- Industrial Security
- Simulation through the full Asset Lifecycle
- Advanced Applications for Power Generation
- Advanced Applications for Industrial Power Generation

These represent the technical building blocks that Honeywell uses in power generation, applied through its globally harmonized business and engineering processes.

Experion for Power

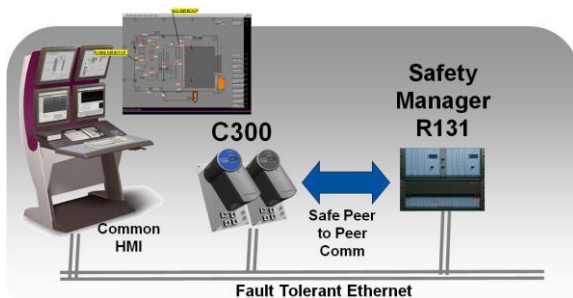
The Experion Process Knowledge System (PKS) is the automation platform across all Honeywell projects. Beginning with the R300 release of Experion, Honeywell has delivered thousands of its new C300 controllers and tens of thousands of its Series C I/O modules. The C300 controller uses industrial Ethernet networks extensively for high performance. The C300 underwent successful cyber security testing at the British Columbia Institute of Technology (BCIT) in 2005. In 2007 the C300 achieved the Mu Security Industrial Control Certification (MUSIC). The MUSIC certification is designed specifically for IP-based process controllers and is closely aligned with the emerging ISA-SP99 security standards. It enables organizations operating critical infrastructure to ensure their network equipment and applications meet industry-defined benchmarks for safety, robustness, resiliency, and conformance.

Beyond the platform itself, Honeywell has developed a set of Experion function blocks designed specifically for control of power generation appli-

cations. These add embedded capability for digital signal acquisition, contact monitoring, rate-of-change management, and “First-out” detection. The advantages of this pre-built power library include not only enhanced system performance, but repeatable engineering of control, HMI, historian, and advanced applications, along with simplified documentation leading to reduced project engineering costs and faster start-ups.

Integrated Burner Management

Burner management systems (BMS) are required to meet the applicable codes for large furnaces (such as NFPA 8502 in the United States). These systems perform both automation and equipment protection in large power



generation applications. Historically BMS have been stand-alone systems that have been integrated into a plant automation strategy using a gateway. Most DCS suppliers do not offer certified BMS solutions, and BMS suppliers do not extend to DCS capabilities. Integration via a gateway has been an unhappy solution at best. In large applications the BMS will contain over 5000

process tags. Engineering a gateway to support automation and HMI with acceptable response times can be challenging. Another challenge is integration of the time-tagging and alarming.

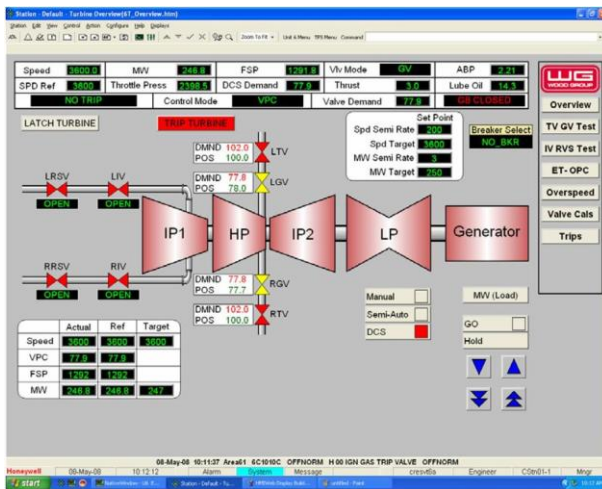
Honeywell has addressed this issue by implementing a certified BMS application in its own Safety Manager system. The Safety Manager serves as a specialized control station in Experion system configurations. It uses the same Fault Tolerant Ethernet infrastructure to communicate peer-to-peer with C300 controllers and with the common Experion Station HMI, greatly simplifying the integration of BMS functions in Experion systems.

Integrated Turbine Automation

In many regions, retrofitting older power plants with new and more reliable automation systems is the major fraction of the power automation market. In such older plants, the turbine control systems are an important part of this upgrade. Many older OEM turbine controls are expensive to maintain and have become a root cause of unplanned outages. But turbine automation is also a highly specialized niche within the automation market. Honeywell, as a non-OEM, cannot support the same level of resources in-

house that turbine OEMs can. To address this, Honeywell has entered into a partnership with Wood Group Turbine Control Services.

Wood Group plc (LON:WG) is a \$4.4B global energy services provider. As the global power services industry has restructured in recent years, Wood Group has worked aggressively to assemble a large team of turbine experts and has entered into direct competition with turbine OEMs for automation and service business.



To address the turbine control market with an integrated platform, Honeywell provides a Turbine Control Solution for Experion, including the operator interface, and modular Experion automation components. This solution offers Wood's world-class application engineering, but is fully integrated with the Experion platform and other Experion applications. Such tight integration improves overall plant reliability and performance. It is also supported by a major supplier like Honeywell. The project list for this partnership

includes not only large steam turbines, but gas turbines, hydro turbines, and large auxiliary turbines.

Fire and Gas Detection, Security, and Simulation

Usually integrated within power stations as a 3rd party solution, fire and gas detection is an area where Honeywell as a corporation is a market leader. Honeywell's Automation and Control business unit brings this expertise to bear as part of their I-MAC capability, giving owners and A/E firms a single source for sensors, protective systems, and integration with the plant's Experion system. This includes the ability to integrate field sensors and alarms to meet IEC 61511 requirements for integrated fire and gas along with emergency shutdown detection (ESD) systems for SIL-3 applications.

Similarly, Honeywell as a corporation is a global leader in building automation and security systems. In fact, the same development organization responsible for the Experion process automation platform is also responsible for Honeywell's building automation platform. Honeywell I-MAC capability includes the ability to integrate any of Honeywell's access and perimeter security and surveillance solutions. As physical security has been

a growing concern at power plants, this capability becomes increasingly attractive to owners and EPCs.

Honeywell also has a long history of simulation work. Its UniSim offering has a view toward making simulation an ongoing part of the plant lifecycle. UOP, a relatively recent Honeywell acquisition, brings immense experience and knowledge of modeling for all types of processes. In particular, UOP's capabilities extend to the newer "clean coal" processes that traditional power plant simulation does not address.

Advanced Energy Solutions

Finally, Honeywell offers a full set of preconfigured applications for central station plants as well as industrial power operations. These applications all run on the Experion platform or on network servers and include:

Industrial Power	Control	Advanced Combustion Control, Master Pressure Control
	Optimization	Plant Simulation, Tie Line Control Plant Performance Optimization, Plant Performance Monitoring
Central Station Power	Control	Unit Coordinated Control, Boiler Control, Steam Turbine Control, Combustion Turbine Control, Hydro Turbine Control, Reciprocating Engine Control, Burner Management, Sootblowing Control, Mechanical Drive Control, Unit Chemistry Management
	Optimization	Unit Simulation, Performance Management, Sootblowing Optimization, Root Cause Analysis, Early Warning and Diagnostic Asset Life Management, Fleet Portfolio Optimization

The Honeywell Solution Portfolio for Power Applications

New Challenges

No business strategy is without challenges. Honeywell has bet on its global presence and culture of continuous improvement. This represents a sensible approach given the company's strong overall position in the process auto-

mation space. Honeywell's sales organization has traditionally had a good ear for the voice of the customer. In order to succeed in power for the long term, the company will need to extend those relationships to include its power project management and engineering teams. Power customers look for long term partnerships with these teams as a way to insure continuity and support for their own unique requirements. Indeed, some suppliers to the power market whose internal processes are not as strong as Honeywell's use such relationships to compensate for a lack of uniform global business processes.

In addition, Honeywell should continue to develop and refine its power industry applications. The use of Experion with Honeywell's Safety Manager as a BMS platform is a good example of using both hardware and software solutions across all vertical industries. The success of Honeywell's alliance with Wood Group is another. Power automation suppliers, including Honeywell, will need to maintain a suite of solutions that specifically address the power industry, but this suite must become increasingly independent of the underlying automation platforms. Future success will come from managing software and service products for vertical industries while supplying long-lived automation platforms that can serve a wide variety of industries and applications. The challenge of doing this well increases as the mix of vertical industries represented in Honeywell's customer base becomes more diverse.

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Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/C13/IndustryTerms/

API Application Program Interface	I-MAC Integrated Main Automation Contractor
B2B Business-to-Business	
BMS Burner Management System	IOP Interoperability
CAGR Compound Annual Growth Rate	IT Information Technology
CAS Collaborative Automation System	MAC Main Automation Contractor
CMM Collaborative Manufacturing Management	MIS Management Information System
CPG Consumer Packaged Goods	OEM Original Equipment Manufacturer
CPM Collaborative Production Management	OpX Operational Excellence
CRM Customer Relationship Management	OLE Object Linking & Embedding
	OPC OLE for Process Control
DCS Distributed Control System	PAS Process Automation System
DOM Design, Operate, Maintain	PLC Programmable Logic Controller
EAM Enterprise Asset Management	PLM Product Lifecycle Management
EPC Engineer-Procure-Construct Firm	RFID Radio Frequency Identification
Enterprise Resource Planning	ROA Return on Assets
HMI Human Machine Interface	RTLS Real-time Location System Management
	SCM Supply Chain Management
	WMS Warehouse Management System

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