2018 Global Edge Controls and Analytics Company of the Year Award

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Background and Company Performance

Industry Challenges

The changing industrial environment is becoming increasingly complex to manage, and fluctuating market conditions continue to impact primary business drivers such as asset reliability and utilization. Other challenges include productivity stagnation, legacy control systems limitation, competitive pressures, and cybersecurity. In comparison to dramatic growth in consumer sectors, industrial businesses grapple with waning productivity, even after reducing waste and production costs. Legacy systems are often not compatible with remote monitoring or control. Outdated manufacturing processes and technologies require onsite workers to manage assets efficiently. Additionally, companies face continual competitive pressure to reduce risk and total cost of ownership while maximizing assets to increase revenue and acquire customers. As companies seek new solutions to stay competitive by digitizing their plants, they also face the mounting pressure of maintaining secure networks and plants.[1]

Emerging trends such as Industry 4.0 and smart manufacturing offer new solutions and are bringing data analytics to a new era. As plants increasingly digitize, original equipment manufacturers and end users anticipate the next wave of innovative products, services, and business models. The Industrial Internet of Things (IIoT) is altering the way companies generate, collect, and analyze data. Generated data is now available faster and at a much higher volume than ever before. This new generational pace requires evolving infrastructure. Traditional operating models involve moving the data from the field devices to the cloud for deeper analysis and route back the feedback and actions. The limitations of this model are latency, responsiveness, cost and business efficiency. Recently, the industry saw the release of innovative solutions such as edge controls; intelligent gateways that securely collect, aggregate, filter, and analyze data closer to industrial processes or the data sources. Access to unprecedented amounts of data in real time and the ability to generate valuable insights to reduce performance variability are critical factors in manufacturing.[2] Edge controls and analytics are poised to revolutionize the way companies will collect, ingest, and drive value-creation for their businesses.

Other factors driving edge analytics adoption are time efficiency and data volumes. Insights generated from the edge facilitate product optimization and orchestrate intelligence across asset fleets. Furthermore, edge intelligence reduces the cost of data transmission and enables real-time decision-making. It also supports remote and preventive maintenance by gathering and analyzing data from the plant floor. Edge devices combine asset data and process IIoT data to ensure a holistic view of operational metrics. Rather than moving massive amounts of data from its origin to a data center or the cloud, edge computing moves the processing power and ability to produce insights

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[1] General Electric Company, *Industrial Internet Control System: Connected Controls Transforming Your Operations* (2017) http://www.geautomation.com/industrial-internet-control-system-iics
[2] *Intelligence at the Edge—An Outlook on Edge Computing* (Frost & Sullivan, September 2017)

closer to the source. Edge computing brings greater potential to deliver results across the manufacturing industry.

Frost & Sullivan expects edge computing to gain traction across other industry verticals such as manufacturing, oil and gas, chemicals, healthcare, and utilities. Edge analytics solution providers play a major role in making manufacturers understand the impact of advanced technologies. Frost & Sullivan predicts edge computing to evolve and estimates 1.7 billion IIoT devices will be connected to edge solutions by 2020.[3]

Ongoing digital transformation initiatives across industries and the increased proliferation of hyper-connectivity exposes industrial control systems to new cybersecurity threats. Legacy systems typically cannot support present-day security mechanisms. Ideally, security must be applied from the edge to the cloud and should span informational technology and operational technology networks and subsystems. Security is essential for reliable operations. IoT devices typically have only as much processing capacity and memory as needed for their tasks. Thus, it is crucial to secure IoT with efficient technologies purposely built for the machine environment. Security costs are low in comparison to the potential devastation from a comprising event. However, IoT devices manufactured without the required components essential for IoT security, such as a way to generate keys on the device or without a mechanism to configure unique identifiers to devices, put companies at risk. Device original equipment manufacturers must use components that have the necessary built-in security capabilities to ensure appropriate device levels, data authentication, and integrity.[4]

While edge analytics is a relatively new solution and is in the early stages of adoption, companies that can create secure platforms with edge to cloud capabilities along with a range of integrated technologies and applications will be well positioned as market leaders.

Visionary Innovation & Performance and Customer Impact

Headquartered in Charlottesville, Virginia, GE Power's Automation and Controls business unit is a leading provider of automation and controls technology and services. Its expertise in industrial software, control systems, and embedded computing platforms to help connect, monitor, analyze, predict, and optimize operations position GE as a market leader. GE is a pioneer when it comes to bridging minds and machines to help industries achieve new levels of performance, production, and profit. GE is also a globally recognized brand with its spectrum of experience and expertise. GE is more than capable of solving its customers' greatest challenges.

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[3] Ibid
[4] *ICS Cybersecurity Market Watch—Key Market Needs and Solution Providers in the ICS Landscape, 2017* (Frost & Sullivan, October 2017)

Pioneers of the Future: Breaking Away from Traditional Control Systems

Frost & Sullivan research indicates that computing will become smarter, faster, smaller, cheaper and lower in power consumption.[5] As processing capabilities are improved, edge computing will grow in computing capabilities but balanced with cloud services that allow for co-existence. Primary drivers for edge computing include faster and closer to device/onboard computing, latency in communication, cost of storage, and responsive operations with secure connectivity. With an estimate of over a billion IIoT devices connected by 2020, outcomes will include faster issue resolutions, reduced latency in communication between systems, and flexibility in embedding software-driven agility across operations. More horsepower will be pushed to the edge, giving rise to the re-emergence of de-centralized computing. As a world-class leader of control systems and software, GE recognizes the advances in computing technology and harnesses its evolving capabilities. GE moves away from control systems as passive devices and disconnected from business outcomes to forge a new path of connectivity, a new paradigm. As a pioneer in the edge computing space, GE is going where no company has gone before with its Industrial Internet Control System (IICS).

GE's IICS is the next generation Predix-ready, modular controls platform that leverages rich data and analytics to turn insights into action. GE designed its IICS solution to help customers meet the demanding challenges by bringing data analytics together with real-time control to unlock new insights and hidden value through controls. The critical link in an IIoT chain for cloud-enabled analytics is GE's Field Agent, an enabled edge device. Field Agents are a rugged, pre-configured solution for secure data collection and easily connects and utilizes GE's Industrial Internet Platform. GE offers a Mini Field Agent that packs a small footprint as a stand-alone gateway and edge compute platform. The Mini Field Agent is ideal for lower power applications. Customers can deliver data to analytics that run in the cloud or bring analytics close to local data sources through locally hosted applications.

With GE's IICS that consists of outcome optimizing controllers, mix-and-match I/O modules, flexible connectivity options, and advanced analytics software and apps, customers can anticipate up to 7% increase in performance, 22% increase in productivity, and reduce maintenance by 40%.[6] GE's IICS optimizes asset and process performance, maximizes productivity, generates new revenue opportunities, and transforms equipment lifecycle. Customer benefits include reduced unplanned downtime, minimized maintenance costs, maximized asset utilization, and increased network and asset security. For example, one of GE's current customers sought to improve their power production operating efficiency while balancing maintenance requirements and output demands. GE developed and implemented a solution that required a high-capacity edge computing platform that connects safely and securely to real-time equipment control while communicating with the Predix Cloud for market data. Pilot customers for GE's new outcome optimization offerings

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[5] *2018 Top Information and Communication Technologies* (Frost & Sullivan, April 2018)
[6] GE Energy Connections, "Industrial Internet Control System Connected Controls Transforming Your Operations," http://www.geautomation.com/download/industrial-internet-control-system-iics (accessed April 2018).

can now identify optimal maintenance times and when to increase their operations. Pilot studies report a 2 to 3% improvement in megawatt output through peak firing, with the potential to deliver more than $5 million of additional profitability with zero anticipated impact to plant outage schedule.

GE's Industrial Internet Control System Portfolio

With GE's IICS, customers can combine control equipment that works best for their industrial assets and processes. The ability to mix-and-match ensures the optimal solution for customers' specific needs. Below is a select view of GE's IICS portfolio of solutions.

Predix Machine

GE's Predix Machine is part of the broader Predix platform and maintains close contact with physical assets while providing the ability to exchange data with cloud-based services securely. The platform offers machine-to-cloud, (M2C) machine-to-machine (M2M), and machine-to-mobile or –human (M2H) application connectivity. Its services include:

- Core Services: Services that support logging and provide security and certificate management

- Application Services: Services that support user management and the Git repository

- Machine Gateway: Services that support the machine gateway, which uses industrial protocols like OPC-UA, Modbus, and MQTT and their corresponding adapters

- Cloud Gateway: Services that provide APIs to build client-side HTTP-compliant applications, allowing communication of different network protocols through tunneling, and establishing proxy settings

- Mobile Gateway: Consists of the WebSocket Server service, which enables applications to host a WebSocket server endpoint.[7]

Mix and Match I/O

Connecting control systems to real-world sensors and actuators can be challenging. With factors such as performance requirements, environmental and space limitations as well as cost, most industrial applications necessitate a mix of I/O connectivity that deploys seamlessly and cost-effectively. GE's I/O solutions provide the freedom to place application-specific I/O anywhere it needs to be in a control design. This design flexibility unlocks the full potential of connected control system solutions like remote monitoring and diagnostics, asset optimization, and predictive analytics. Features that make GE's I/O solutions the optimal choice are support for common communication options, remote real-time diagnostics, modularity, scalability, improved availability, and easy maintenance.[8]

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[7] GE Digital, "Predix Machine Overview," Predix Developer Network, https://docs.predix.io/en/content/service/edge_software_and_services/machine/predix-machine-overview (last modified May 3, 2018, accessed May 21, 2018).
[8] General Energy Connections, "GE Mix & Match I/O," https://www.geautomation.com/download/mix-match-io (accessed May 2018).

Equipment Insight, Intelligent Applications, and Professional Services

Equipment Insight 2018 is a comprehensive monitoring and analytics solution for equipment health. Equipment Insight utilizes data from distributed industrial equipment and turns it into actionable insights. Features include fully configurable data blueprints and asset models, configurable dashboards, alerts to detect anomalies in asset performance, and condition monitoring with Criticality Analysis to help clients focus on critical asset issues, and Case Management and Recommendation Management to track asset issues and drive timely resolution. As a ready-made cloud application enabled by GE's Predix system, there are several advantages of Equipment Insight. Edge computing conserves network bandwidth and dramatically decreases associated costs, reduces latency by managing, processing, and storing data on the edge, improves time to action and makes applications more resilient to periods of no connectivity while increasing security of sensitive material by allowing onsite analysis.

Predix goes further than equipment monitoring and diagnostics. Predix provides a platform that clients can develop and deploy custom industrial applications that run close to the asset—hosted on the Field Agent—or remotely, on the Predix Cloud. Industrial applications can enhance product performance or provide unique service offerings that differentiate a client's product from the competition. GE recognizes that customers know their own business best; thus, GE leverages its clients' knowledge to create new product capabilities that can be updated and remotely managed continuously either in the cloud or on-site.[9]

GE's IICS extensions are intelligent applications and digital services along with professional services. GE A&C's cloud-based offerings include Controller Health Monitoring, and Equipment Insight. GE also provides its applications for customer use, or customers can create their own application and analytics by leveraging their uniquely attuned business knowledge. Customers can also run applications and analytics locally with the Field Agent as a stand-alone device or embedded in an Outcome Optimizing Controller. GE's intelligent applications are built using modern software technology and languages and can communicate with controllers through well-defined interfaces. GE's professional support services help customers become connected, gain insights, and get optimized. GE assist customers to digitize their machines by getting assets connected and analyzed. With GE professionals, customers can expect customized alerts and analytics. Furthermore, GE offers predictive analytics, process consulting, and digital modeling.

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[9] General Electric, "Edge Insight," http://www.geautomation.com/predix-edge/index.html (accessed May 2018).

A Natural Evolution: Outcome Optimizing Controls Have Arrived

With its recent release of the PACSystems RX3i CPx400 series, GE created a new industry standard for outcome optimizing controls—the first of its kind. Until now, traditional control systems faced limited controller data, antiquated programming languages, and restricted to single machine/single plant view. GE's PACSystems RX3i CPx400 series moves beyond the traditional control systems as the industry's first outcome optimizing controllers with dual redundancy capabilities. The controller sets itself apart with its robust processing capability and its ability to improve business outcomes by being able to perform maintenance and application updates while the application is running online/inline. Coupled with edge technology, the controller augments real-time deterministic control and provides near-real-time advice through strategic computation. This next-generation connected controller is ideal for outcome optimizing control applications in rugged conditions. Traditionally, control systems operate the process based on set points. However, GE's outcome optimizing edge controllers leverages a judicious blend of cutting-edge hardware and next-gen software to drive process control based on real-time operating conditions. The control system delivers the high performance and flexibility needed to run applications reliably across water/wastewater, metro, industrial steam, automotive, chemical, oil and gas, discrete manufacturing and modular machine designs.

GE's out-of-the-box solution equips customers with a flexible, intelligent, highly available system that helps to ensure maximum uptime while reducing the total cost of ownership. The controller specifications include a sizeable working memory to accommodate large programs, extensive data storage (64 MB) for user programs, and a quad-core high-speed microprocessor (with Type 1 hypervisor that not only runs applications faster but also allows Predix machine or the connectivity solution of choice to run simultaneously in a safe and cooperative manner without impacting the real time deterministic controls. It also supports PROFINET with input/output update rates as fast as 8 milliseconds for up to 32 devices. The CPx400 series Ethernet interface rates can also reach up to 1 gigabit per second. This series facilitates rapid, reliable data interchange that today's industrial businesses need. Backed by GE's expertise and 40 years' experience, the controller design enables secure operations and connectivity from edge to cloud. GE also created a Linux-based Edge capability, for consumers who choose not to have a direct connection with GE or any other cloud. The CPx400 series offers a best-in-class high-availability control system for concurrent maintainability and elimination of single points of failure thus increasing uptime.[10]

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[10] GE Energy Connections Automation & Controls, "PACSystems RX3i CPx400 series", http://www.geautomation.com/download/pacsystems-rx3i-cpx400-series-outcome-optimizing-controls (accessed April 2018).

Layers of Security: The Chain of Trust

The digital transformation initiatives across industries create new exposures to cybersecurity threats. Legacy control systems protected with combined physical and electronic perimeters may no longer be sufficient in keeping industrial assets secure. As a member of the Trusted Computing Group, GE uses industry best practices in the protection and detection across its suite of IICS portfolio. Central to GE's security strategy to protect industrial assets, processes, and information is its Defense-in-Depth strategy at both the product and system level. Rather than rely on one single security technology, GE builds security into every layer—from its hardware to the cloud. GE's IICS foundation and every interface and communication medium have GE's Defense-in-Depth cybersecurity embedded to create a chain of trust. Key security features include multi-level access controls, secure network configuration, Trusted Platform Module (TPM) capabilities, authenticated communications and encryption utilization initially at the supervisory layer and in the future all the way to the controls, data and software protection (from firmware to the cloud) using signed software, secure boot, encryption capability, and GE's OPC UA Global Discovery service which can be used to discover and authenticate devices and provide authentication and authorization of users as part of an integrated set of security services.

A Rich Heritage in Technology Leadership and Commitment to Quality

Its history of innovation and dedication to research and development positions GE as an industry leader in asset management and performance technologies. By continuously investing millions of dollars in research, GE gained a wealth of knowledge and experience that it uses to create groundbreaking digital solutions in the era of IIoT. Furthermore, as a globally recognized brand with a reputation as being technologically driven, GE offers a comprehensive solutions portfolio. Its diversified portfolio differentiates itself from other market offerings by providing an end-to-end suite of control and software capabilities that drive connectivity and allows customers to choose what works for their specific needs. GE's ability to bring reliable performance, advance security (based on TPM), mix-and-match I/O, and high availability with low switchover times truly set it apart from a market awash with traditional control systems.

GE's customers span a spectrum of industries, and the company is keenly aware of each industry's application-specific regulation. The company created specially designed programs, applications, and protocols to accommodate and meet the diverse needs of its customers. The initiative enables GE to measure customer needs and satisfaction with statistical tools and shows where improvements are necessary. When choosing to collaborate with GE, customers have access to around the clock emergency support, online case management, forums, and technical support as well as on-site and online training services and consultations. GE partners with customers from concept to implementation and post-purchase. GE understands that implementing an IIoT strategy can be challenging, which is why GE is ready to assist its customers every step of the way.

Conclusion

Changing industrial environments and market conditions require new solutions for asset reliability and utilization. Emerging trends such as smart manufacturing and digitalization are the next wave of innovative solutions. As the Industrial Internet of Things continues to evolve, some companies are differentiating themselves in the market by offering devices that can harness the power of new technologies' capabilities, especially in the developing domain of edge analytics. General Electric's (GE) Industrial Internet Control System (IICS) and its release of the PACSystems RX3i CPx400 controller series sets an unprecedented industry standard for edge controls and analytics. With its foundational history of quality dedication, commitment to continued innovation, world-class customer support, and its strong overall performance, GE earns Frost & Sullivan's 2018 Company of the Year Award in the global edge controls and analytics market.

Significance of Company of the Year

To receive the Company of the Year Award (i.e., to be recognized as a leader not only in your industry, but among your non-industry peers as well) requires a company to demonstrate excellence in growth, innovation, and leadership. This kind of excellence typically translates into superior performance in three key areas: demand generation, brand development, and competitive positioning. These areas serve as the foundation of a company's future success and prepare it to deliver on the two criteria that define the Company of the Year Award (Visionary Innovation & Performance and Customer Impact).

- Acquire competitors' customers
- Increase renewal rates
- Increase upsell rates
- Build a reputation for value
- Increase market penetration

- Earn customer loyalty
- Foster strong corporate identity
- Improve brand recall
- Inspire customers
- Build a reputation for creativity

DEMAND

BRAND

Company of the Year

COMPETITIVE POSITIONING

- Stake out a unique market position
- Promise superior value to customers
- Implement strategy successfully
- Deliver on the promised value proposition
- Balance price and value

Understanding Company of the Year

As discussed above, driving demand, brand strength, and competitive differentiation all play a critical role in delivering unique value to customers. This three-fold focus, however, must ideally be complemented by an equally rigorous focus on Visionary Innovation & Performance to enhance Customer Impact.

Key Benchmarking Criteria

For the Company of the Year Award, Frost & Sullivan analysts independently evaluated two key factors—Visionary Innovation & Performance and Customer Impact—according to the criteria identified below.

Visionary Innovation & Performance

Criterion 1: Addressing Unmet Needs
Criterion 2: Visionary Scenarios through Mega Trends
Criterion 3: Implementation Best Practices
Criterion 4: Blue Ocean Strategy
Criterion 5: Financial Performance

Customer Impact

Criterion 1: Price/Performance Value
Criterion 2: Customer Purchase Experience
Criterion 3: Customer Ownership Experience
Criterion 4: Customer Service Experience
Criterion 5: Brand Equity

Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate Award candidates and assess their fit with select best practice criteria. The reputation and integrity of the Awards are based on close adherence to this process.

	STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1	Monitor, target, and screen	Identify Award recipient candidates from around the globe	• Conduct in-depth industry research • Identify emerging sectors • Scan multiple geographies	Pipeline of candidates who potentially meet all best-practice criteria
2	Perform 360-degree research	Perform comprehensive, 360-degree research on all candidates in the pipeline	• Interview thought leaders and industry practitioners • Assess candidates' fit with best-practice criteria • Rank all candidates	Matrix positioning of all candidates' performance relative to one another
3	Invite thought leadership in best practices	Perform in-depth examination of all candidates	• Confirm best-practice criteria • Examine eligibility of all candidates • Identify any information gaps	Detailed profiles of all ranked candidates
4	Initiate research director review	Conduct an unbiased evaluation of all candidate profiles	• Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles	Final prioritization of all eligible candidates and companion best-practice positioning paper
5	Assemble panel of industry experts	Present findings to an expert panel of industry thought leaders	• Share findings • Strengthen cases for candidate eligibility • Prioritize candidates	Refined list of prioritized Award candidates
6	Conduct global industry review	Build consensus on Award candidates' eligibility	• Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates	Final list of eligible Award candidates, representing success stories worldwide
7	Perform quality check	Develop official Award consideration materials	• Perform final performance benchmarking activities • Write nominations • Perform quality review	High-quality, accurate, and creative presentation of nominees' successes
8	Reconnect with panel of industry experts	Finalize the selection of the best-practice Award recipient	• Review analysis with panel • Build consensus • Select winner	Decision on which company performs best against all best-practice criteria
9	Communicate recognition	Inform Award recipient of Award recognition	• Present Award to the CEO • Inspire the organization for continued success • Celebrate the recipient's performance	Announcement of Award and plan for how recipient can use the Award to enhance the brand
10	Take strategic action	Upon licensing, company able to share Award news with stakeholders and customers	• Coordinate media outreach • Design a marketing plan • Assess Award's role in future strategic planning	Widespread awareness of recipient's Award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of our research process. It offers a 360-degree view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, leading to errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry participants and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, enables clients to accelerate growth and achieve best-in-class positions in growth, innovation, and leadership. The company's Growth Partnership Service provides the CEO and the CEO's Growth Team with disciplined research and best practice models to drive the generation, evaluation, and implementation of powerful growth strategies. Frost & Sullivan leverages more than 50 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on six continents. To join our Growth Partnership, please visit http://www.frost.com.