Magic Quadrant for Industrial IoT Platforms

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CIOs in industrial enterprises must approach IIoT platforms cautiously. Adoption is accelerating, but complex IT/OT integration is emergent and often focused on narrowly defined outcomes. Focus on intra- and interplatform integration, along with data and device management, to ensure platforms scale.

Strategic Planning Assumption

By 2023, 30% of industrial enterprises will have full, on-premises deployments of IIoT platforms, up from 15% in 2019.

Market Definition/Description

Gartner defines the industrial Internet of Things (IIoT) platform market as a set of integrated software capabilities to improve asset management decision making and operational visibility and control for plants, infrastructure and equipment within asset-intensive industries and environments.

The IIoT platform is differentiated from legacy operational technology (OT; see Note 1) because of the IIoT platform's capabilities:

- To cost-effectively collect higher volumes of high-velocity, complex machine data from networked IoT endpoints

- To orchestrate historically siloed data sources to enable better accessibility (across the enterprise and with partners)

- To improve insights and actions across a heterogeneous asset group through specialized analysis of the data

The IIoT platform performs several functions:

- It monitors IoT endpoints and event streams.

- It supports and/or translates a variety of manufacturer and industry proprietary protocols.

- It analyzes data at the edge and in the cloud.

- It integrates and engages IT and OT systems in data sharing and consumption.

- It enables application development and deployment.

- It can enrich and supplement OT functions for improved asset management life cycle strategies and processes.

In some emerging use cases, the IIoT platform may obviate some OT functions, such as industrial control and automation or elements of human-machine interface (HMI) capabilities.

The IIoT platform, in concert with the IoT edge and through enterprise IT/OT integration, prepares asset-intensive industries to become digital businesses by enhancing and connecting their core business with external business partners. The IIoT platform may be consumed as a technology suite, or as an open and general-purpose application platform, or both in combination. The platform is engineered to support the requirements of security, safety and mission criticality associated with industrial assets and their operating environments. The IIoT platform software that resides on and near devices — such as controllers, routers, access points, gateways and edge compute systems — is considered part of the "distributed IIoT platform."

IIoT Platform Capabilities

The IIoT platform is composed of the following technology functions:

Device management — This function includes software that enables manual and automated tasks to create, provision, configure, troubleshoot and manage fleets of IoT devices and gateways remotely, in bulk or individually, and securely.

Integration — This function includes software, tools and technologies, such as communications protocols, APIs and application adapters, which minimally address the data, process, enterprise application and IIoT ecosystem integration requirements across cloud and on-premises implementations for end-to-end IIoT solutions. These IIoT solutions include IIoT devices (for example, communications modules and controllers), IIoT gateways, IIoT edge and IIoT platforms.

Data management — This function includes capabilities that support:

- Ingesting IoT endpoint and edge device data

- Storing data from edge to enterprise platforms

- Providing data accessibility (by devices, IT and OT systems, and external parties, when required)

- Tracking lineage and flow of data

- Enforcing data and analytics governance policies to ensure the quality, security, privacy and currency of data

Analytics — This function includes processing of data streams, such as device, enterprise and contextual data, to provide insights into asset state by monitoring use, providing indicators, tracking patterns and optimizing asset use. A variety of techniques, such as rule engines, event stream processing, data visualization and machine learning, may be applied.

Application enablement and management — This function includes software that enables business applications in any deployment model to analyze data and accomplish IoT-related business functions. Core software components manage the OS, standard input and output or file systems to enable other software components of the platform. The application platform (for example, application platform as a service [aPaaS]) includes application-enabling infrastructure components, application development, runtime management and digital twins. The platform allows users to achieve "cloud scale" scalability and reliability and deploy and deliver IoT solutions quickly and seamlessly.

Security — This function includes the software, tools and practices facilitated to audit and ensure compliance, as well as to establish and execute preventive, detective and corrective controls and actions to ensure privacy and the security of data across the IIoT solution.

Targeted Industrial Enterprises

For this market evaluation, Gartner focuses on three asset-intensive industries:

- Manufacturing and natural resources, which include the subsectors of automotive, consumer nondurable products, energy resources and processing, heavy industry, IT hardware, life sciences and healthcare products, and natural resources and materials

- Transportation, which includes the subsectors of air transport, motor freight, pipelines, rail and water, warehousing, couriers, and support services

- Utilities, which include the subsectors of electrical, gas and water

Differentiating the IIoT Platform for General IoT

The industrial Internet of Things is distinguished from general IoT in that IIoT technologies are focused and architected for use within asset-intensive industries and related environments (typically regulated). The integration, extensibility and impact of IIoT spans IT and OT systems. The IIoT solution collects, aggregates, orchestrates and analyzes data to:

- Accelerate asset management decision making

- Illuminate operational visibility, which reduces the costs to automate and control assets, infrastructure and equipment

Some of the qualities of IIoT platforms include:

- IIoT platforms must be extensible through integration with both OT and enterprise IT applications. Integration must be secure and robust.

- Reliability and resilience are fundamental in most IIoT solutions, mainly because there may also be regulated safety factors involved. Included in reliability and resilience are the monitoring and management of critical devices and services that require 100% availability. Therefore, IIoT solutions are usually designed for failure identification and the ability to recover from failure. These factors add to the architectural challenges.

- Deployment requirements in IIoT are complex and often regulated. This situation results in significant integration challenges to ensure the safety of life, mission criticality of systems, and data security and privacy. The primary enterprise applications — for example, manufacturing execution systems (MES), ERP, asset performance management (APM)/condition-based maintenance (CBM) and enterprise asset management (EAM)/computerized maintenance management system (CMMS) — drive the solutions, with IoT services running on the cloud or on-premises or as a hybrid implementation. Today, IIoT must be able to address on-premises deployment requirements to operate in disconnected scenarios, as well as cloud requirements.

- IIoT has edge computing requirements with delegated services from both the cloud and IoT end devices, which have multiple sensors throwing off large amounts of data — often at high velocity. Edge computing includes edge platforms and edge gateways running mostly on-premises. IoT and OT devices with a multitude of different protocols (standard and proprietary) connect through gateways and edge platforms with significant computing capabilities. IIoT is mostly a five-tier architectural model — device, gateway, edge computing, platform and enterprise application integration.

- It is important to note that within enterprise applications is the use of, and increasing reliance on, third-party data services by industrial enterprises. These services may include data critical to operations and production planning, such as weather; prevailing prices for commodities and goods and services; customization demands; forward and reverse logistics; and other supply chain considerations.

- IIoT solutions have a low number of endpoints (in the thousands or tens of thousands) compared with commercial and consumer-centric IoT solutions which may reach into the hundreds of thousands or millions. The volume of data generated by the endpoints, along with the frequency and velocity of data, is generally very high. Sensors are often transmitting data at millisecond intervals. IIoT solutions are device-light but data-heavy.

- The data generated by IIoT sensors is often critical to the operation of end devices and may also contribute to the safety of the environment. Hence, processing and analyzing at the edge are more significant in IIoT solutions to address safety, as is emphasizing uptime and minimizing data loss through sophisticated and segmented network design. Data also contributes greatly to efficiency and availability targets, which drive cost reductions and extend the functional lives of assets.

Magic Quadrant

Figure 1. Magic Quadrant for Industrial IoT Platforms

Source: Gartner (June 2019)

Vendor Strengths and Cautions

Accenture

Accenture initially delivered its Connected Platforms as a Service (CPaaS) IIoT platform in 2015 as a hybrid, multicloud, stand-alone software platform. The platform provides a range of functionality for IoT spanning the six core technology stack areas for IoT platforms, using Accenture intellectual property (IP), third-party and open-source solutions. CPaaS is positioned to address IoT use cases across many industry sectors — consumer and commercial, in addition to industrial.

The majority of CPaaS offerings have been developed by Accenture, with reliance on technology partners mostly for device management and security capabilities. CPaaS also supports common open-source technologies in areas such as protocols (for example, MQTT), data management and analytics. In 2018, Accenture acquired Opalytics' IP (analytics IP only), Kogentix (big data and artificial intelligence [AI] solutions), Mindtribe (hardware engineering), and Pillar (embedded software) and invested in Malong Technologies (computer vision) and Ripjar (data and security intelligence).

CPaaS is extensible and configurable for specific customer needs. Accenture provides off-the-shelf applications in transport, spaces, operations and commerce. Deployment choices include on-premises, on infrastructure as a service (IaaS) on any cloud, and distributed edge-to cloud options. It may also be integrated with Amazon Web Services (AWS) and Microsoft Azure services and provides app portability across deployment options.

Accenture prices CPaaS on a consumption basis including tiered subscription and/or transactions and negotiates price points with customers based on the scope of deployment (number of connected assets), solution value and targeted predefined use-case outcomes. The firm can also sell vertically focused applications with the IIoT platform. Accenture is also working with finance partners to provide outcomes as a service.

Gartner has observed CPaaS deployments on a global basis. Vertical industries in the customer base include heavy industrial manufacturing, automotive, utilities, natural resources, and transportation and logistics. Deployments typically leverage Accenture's professional services for design, configuration and delivery of the solution, including customization of analytics and application functionality.

CPaaS is suited to owner/operator organizations with heterogeneous connected assets desiring preintegrated IoT services and managed delivery and deployment, as part of an overall end-to-end hardware-to-software-to-business-application-service solution. While CPaaS is appropriate for industrial asset monitoring and related analytics in some industrial environments, the company does not focus more on industrial use cases as compared with other sectors. Furthermore, Accenture's CPaaS has not demonstrated a significant ecosystem of developers outside of Accenture. Observed

and verifiable industrial use cases include asset monitoring and predictive maintenance of in-field, industrial assets, such as heavy industrial equipment and fleet management.

Please note that Accenture's CPaaS will be renamed "Applied Intelligence Platform (AIP)" on its next release in October 2019.

Strengths

- Accenture has a broad business process knowledge across many vertical markets that is based on Accenture's long history as a professional services provider.

- Accenture has demonstrated the ability to take customers from ideation to proof of concept to production-scale solution deployments.

- CPaaS leverages open-source and Accenture IP to offer a broad range of IIoT platform capabilities. The platform capabilities are enhanced by vertical apps, as well as the capability for customization to meet specific customer-desired outcomes. In our survey, customers evaluated CPaaS most highly for its analytics and security.

- Accenture has proven, flexible deployment models, including hybrid, multicloud, stand-alone software platforms, and deployment on multiple cloud platforms (such as Microsoft and AWS).

Cautions

- Accenture needs to build its catalog of production customers integrating CPaaS into legacy OT technologies and systems in asset-intensive, regulated environments.

- Accenture offers its CPaaS developer portal by invitation only to select clients and partners, and it does not manage a formal market-facing developer program.

- Accenture's CPaaS is not supported by third-party service providers and has a limited developer program and training for citizen developers at customers, leading to a strong need to engage with Accenture for services.

- Accenture is still building its portfolio, experience and capabilities in deploying CPaaS in mission-critical and regulated industrial settings.

Altizon

Altizon's Datonis IIoT platform is a hybrid, multicloud, stand-alone software platform, based on in-house development using open-source software building blocks. The Datonis IIoT platform spans the full range of required IIoT platform components for this market and is extensible and configurable for industrial production and business operations. Deployment choices include on-premises, on IaaS on any cloud, or integrated with AWS and Microsoft Azure services.

Altizon has production customers in multiple industrial sectors, including automotive, manufacturing, consumer product manufacturing, heavy industrial manufacturing, and water and electrical utilities. Altizon's industrial business unit has domain experts who engage with customers and partners, identifies trends, and drives products and offerings. India is Altizon's center of gravity for sales and services for its IIoT platform. The company continues to expand its presence into North America and Europe.

Altizon prices the Datonis IIoT platform on a tiered subscription basis with price points based on the scope of deployment (number of connected assets).

Although the Datonis platform is an industry-agnostic IoT platform, Altizon has proven capabilities in industrial asset monitoring and related analytics across automotive and chemical manufacturers, oil and gas, and utility companies. Altizon does not exhibit experience or strength via past performance in the transportation and logistics subsectors. Observed and verifiable industrial use cases include real-time monitoring of quality metrics data across production environments in manufacturing, utilities, and transportation and logistics for operations and business constituencies. Specifically, Altizon has proven capabilities for overall equipment effectiveness (OEE) and CBM for assets for line speed optimization, throughput improvement, energy consumption, and reduction in quality defects, and tools and spares cost. Altizon also has presented client references visibility into the operating parameters (for example, vibration, suction pressure and bearing temperature) of assets for predictive failure and spares management.

Strengths

- The Datonis IIoT platform is differentiated as it provides testing capabilities such as simulators to generate devices, events, users and configuration objects in the platform. Developers also can test API integrations with other services and generate loads for scale analysis.

- The Datonis IIoT platform acts as the central repository for all device and gateway policies, and it provides a REST API to provision and manage the software life cycle of devices and gateways.

- The Datonis Edge capabilities are built on the well-known, open-source Eclipse Kura gateway framework and provide built-in support for industrial connectivity protocols, edge analytics and machine learning.

- The Datonis IIoT platform has demonstrated successes within industrial enterprises for using IoT to augment and bridge IT and OT for industrial use cases relating to production processes, operations management and business planning and logistics.

Cautions

- Altizon has a small base of customers outside of India. The company's efforts for sales and service in the U.S. and Europe remain small.

- The Datonis IIoT platform does not support the interpretation, transformation and handling of audio or video data.

- Altizon lacks a productive indirect channel to market, which reduces the number of sources that are knowledgeable of the Datonis IIoT platform and that can sell the platform.

- Altizon does not maintain a standardized security engineering framework, nor does the company engage external auditors to provide customers assurances relating to secure platform development and testing processes.

Atos

Atos leverages established products and assets from various parts of the business, including Worldline, Worldgrid and Bull. The company also partners with third-party independent software vendors (ISVs) and uses open-source software technologies for its Atos Codex IoT. The platform is available as either an on-premises or a cloud deployment model. Features such as the Codex Connectivity Platform (CCP), Codex Cloud Industrial Supervision (CIS) — the edge computing cornerstone for IIoT — and the Codex IoT Services Hub play critical component capability functions in IIoT architectures.

Atos Codex Fabric is predominantly based on the use of open-source technologies from the Apache Software Foundation from data ingestion through to data visualization. Atos has adopted more of a "best-of-breed" third-party analytics service approach rather than build its own capabilities. This approach does provide a competitive overall product capability and offers relatively good ease of use and deployment and implementation as evidenced in some customer feedback scores.

Atos — with its Codex Lynx and Codex IoT Suite capabilities — provides a unique IIoT partner for utility companies seeking new opportunities (such as analytics in IoT) and specific capabilities (such as a mesh network of smart nodes and swarm computing). Looking to transfer these capabilities to other industrial environments, Atos has leveraged its partnership with Siemens to address manufacturing and transportation environments.

Strengths

- Atos has aligned its approach to industrial IoT industries and offers the Siemens Mindsphere platform, enabling the Atos Codex IoT Suite to focus on legacy industrial control systems.

- Atos maintains visibility and influence in the utility industry, allowing the company to transition customers from traditional OT systems to hybrid IT/OT systems.

- Security emerges as a strong capability of the Codex IoT Suite, leveraging the combination of security technologies from Bull Horus and Worldline.

- The Atos IoT service management framework provides a unique approach to manage the performance of the IIoT platform against business key performance indicators (KPIs) and SLAs.

Cautions

- Atos' Codex IoT is not supported by third-party service providers and has no developer program and training for citizen developers.

- Atos lacks a broad IIoT focus in terms of OEM relationships. To date, Atos focuses mainly on Siemens solutions.

- Atos' IIoT sales and delivery experience lie predominantly in the U.S. and Europe with a growing presence in Asia/Pacific.

- The Atos platform is curated from products developed within disparate business units, which has led to customer dissatisfaction with platform deployment.

Davra

Davra delivered its industrial IoT platform (the Davra IoT Platform) to general availability in January of 2013. The platform covers the full range of functionality expected in this market, spanning application enablement, integration, data management, analytics, device management and security. Davra's platform is based on a range of open-source components, such as TensorFlow for machine learning in support of analytics, Docker and Node.js in support of device management, and OpenID and Passport.js for security. While the large number and wide range of open-source technology adds complexity to the overall architecture, Davra integrates these components into a cohesive and seamless platform.

The ability to deploy the Davra IoT Platform in a completely on-premises, disconnected manner, as well as in the cloud, allows Davra to address a wide range of use cases and environments. The functionality available on-premises and in the cloud is identical. While Davra has been implemented across a range of sectors, it has a base of strength in transportation and logistics (including governance agencies managing public transport networks). It supports asset monitoring and predictive maintenance applications for fleets — trains, buses, forklifts, cranes and other types of vehicles. The vendor also has end users in utilities and manufacturing who have implemented asset monitoring applications, demonstrating integration between OT and IT environments.

In addition to a significant focus on leveraging open-source technologies, Davra's go-to-market approach is very partner-centric. The vendor makes limited sales and marketing investment on its own. Instead, the company relies on its partner network (key partners such as Cisco), to amplify its market presence and enter key accounts. This approach is effective for Davra but also brings the risk of overreliance on a major partner that is also a competitor to some degree in this market. In

addition, the partner-oriented approach means that Davra's relationship with end users of the platform is sometimes indirect.

The Davra IoT Platform is best suited to environments that involve a diverse set of endpoints from which data must be ingested, in environments where on-premises deployment is critical. Organizations that seek an extensible platform that enables complex applications may see Davra's open-source roots as an advantage for deployment flexibility but should balance this against the challenges of managing such environments.

Strengths

- Reference customers identify the platform's ease of use (primarily of the application development/enablement, integration and analytics capabilities) as a key factor in their selection and use of Davra.

- In terms of service and support, reference customers generally provide positive feedback on the vendor's ability to provide timely and high-quality responses to support issues.

- Davra's platform is used in a variety of verticals, with a strength in the transportation and logistics vertical. Davra's installed base includes numerous examples of customers applying the platform for monitoring and predictive maintenance in fleet management and transport network scenarios.

- The Davra platform is deployable on-premises or in the cloud with identical functionality, and Davra presented reference customers with production on-premises deployments.

Cautions

- The partner-centric go-to-market approach means Davra has a less direct focus on and interaction with end users, and it incurs the risk of reliance on partners to generate sales.

- Davra lacks the packaged applications that some resource-constrained enterprises have come to rely on and that many of Davra's competitors provide.

- The majority of Davra's installed base is in EMEA, with some presence in Asia/Pacific. The limited traction to date in North America represents both a challenge and a significant opportunity for the vendor.

- A significant percentage of Davra's references are from partners using the Davra platform to manage customer assets and not from users with production deployments in complex industrial environments.

Eurotech

Eurotech provides industrial IoT customers with two off-the-shelf IIoT platform integration capabilities: its edge computing platform, Everyware Software Framework (ESF), and its data-center-

level platform, Everyware Cloud (EC). Approaching industrial IoT from the OT perspective, Eurotech provides, in addition to ESF and EC, IoT gateways as a first step to provide machine-to-machine (M2M) and IoT connectivity for OT assets to IT.

Built as a microservices architecture without any dependencies on any technology that cannot be deployed on-premises, Eurotech IIoT platforms can be deployed as IoT edge middleware (Everyware Software Framework) or on-premises and cloud-based (Everyware Cloud) options. Positioned as a differentiator and as a way for customers to avoid vendor lock-in, Eurotech maintains an open-source approach to its IIoT platforms by driving the edge and cloud platforms based on Eclipse Kura and Eclipse Kapua projects, respectively.

Two key partnerships bring stronger integration capabilities to the Eurotech IIoT platforms: Red Hat and VMware. The two message routing and integration products Red Hat JBoss AM-Q and Fuse from Red Hat are applied as part in both platform constructs to connect to external applications. The ability to further secure, monitor and manage the edge infrastructure using vSphere virtualization and integrating with other products is what the partnership with VMware brings to Eurotech's customers. More recently, Cloudera has become an additional partner to the Eurotech ecosystem, improving the solutions' overall analytical capabilities.

The success of Eurotech on the IIoT market has been focused on bringing its experience and know-how from OT embedded environments to IT vendors and the IoT. The Eurotech IoT platform is best suited to industrial environments that require industrial gateways from which data must be ingested, in environments where on-premises deployment is critical.

Strengths

- Eurotech was an early provider of IIoT platform vendors squarely focused on the OT environment and built its IIoT architecture from the IoT gateway to the IoT device middleware (ESF) and to the cloud-based platform (EC).

- The ability to "easily" integrate with other vendors at an edge or cloud level is possible based on the open-source Eclipse project foundations. Integration is also possible based on the native client connectivity solution in ESF and preintegrations in EC for Microsoft Azure, AWS, Software AG and SAP.

- Leveraging Red Hat OpenShift technology allows Eurotech the flexibility of deployment anywhere. This partnership has allowed Eurotech to leverage products such as JBoss AMQ and Fuse as integration tools across the end-to-end IIoT platform

- As a manufacturer of hardware and a developer of software, Eurotech maintains a strong position within the industrial segment at the edge-to-cloud part of an IIoT architecture.

Cautions

- Broad and deep analytics is not part of the core of Eurotech's IIoT platform, and where provided to customers, the analytics received poor scoring on capability, ease of use and meeting expectations.

- Eurotech lacks a programmatic structure for sales partners and channels and maintains an overall limited marketing strategy without any specific propositions tailored for the industrial subsegments.

- Eurotech has not demonstrated a deep base of customers or experience in the utility industry.

- Eurotech's customer base and focus are in the U.S. and Europe with few examples of customers domiciled in the rest of world.

Exosite

Exosite's Murano IIoT platform became generally available in June 2016. Murano is an evolution of various capabilities the vendor has had in the market for several years. Murano packages a combination of open-source and third-party capabilities to deliver the full range of functionality expected in such a platform, spanning application enablement, integration, data management, analytics, device management and security. While reference customers report usage of all these capabilities, Exosite's emphasis is on analytics, as demonstrated by the ExoSense cloud-based analytics applications aimed at predictive analytics for asset maintenance, as well as monitoring of connected products.

Murano and ExoSense are delivered as managed services and can be deployed on public cloud infrastructure (including AWS and Microsoft Azure). Exosite has extensively API-enabled the Murano platform, which allows it to be integrated with various other technologies. The RESTful API approach and modern architecture of Murano contributes to a positive customer experience with integration and ease of use, which contributes to Murano's attractiveness for OEMs seeking to embed it in their own solutions. It provides a range of connectivity capabilities "out of the box" to enable interaction with diverse device types.

Unlike other vendors in this market, Exosite's primary go-to-market approach targets OEMs. Exosite's installed base includes several significant OEMs that have licensed Murano and ExoSense to develop predictive maintenance solutions that they offer to end customers. Because of the approach to the market, the clear majority of Exosite's current experience and installed base is in the manufacturing sector, with far fewer customers in other key industries, such as utilities and transportation/logistics. Most of the vendor's customers are in North America and Asia, with a much more limited presence (both in terms of customers and resellers) in Europe.

The OEM orientation of Exosite's solution and approach to the market has resulted in less depth of on-premises capabilities. While the Murano platform can be deployed on-premises via containerization techniques and via the Exosite Gateway Engine functionality, the vendor presents

limited reference customers with such deployments. Rather, most customer examples appear to be cloud-centric in nature, with data being harvested from edge devices and then processed through the Murano platform and by ExoSense in the cloud. This "edge to cloud" deployment pattern was exhibited by nearly all reference customers presented by the vendor in support of this research.

The Exosite Murano platform is best-suited for OEMs and other organizations seeking cloud-oriented capabilities for processing and analysis of data from connected products. Organizations seeking completely on-premises deployments, including strong device management and deep integration with legacy OT, will need to validate Exosite's capabilities in their specific environments.

Strengths

- Customers identify ease of use of the platform (primarily of the application enablement, analytics and administration capabilities) as a key factor in their selection and use of Murano.

- Ease of use and integration contribute to rapid time to value, and flexibility pricing and licensing further contribute reference customers expressing strong positive ROI and an overall positive perception of value.

- Customers generally provide positive feedback on the vendor's ability to provide timely and high-quality responses to support issues.

- The manufacturing sector for connected products is Exosite's main base of strength, and its experience working with OEMs can be leveraged across that sector.

Cautions

- The Murano platform leverages Lua, a scripting language for which skills are scarce, to provide serverless scripting functionality. Customers that use the ExoSense application are not required to work with Lua, but advanced customers wishing to customize the platform may find this an impediment.

- Most deployments are edge to cloud, or otherwise cloud-centric in nature, and as a result Exosite will be challenged to secure new business with industrial accounts seeking purely on-premises solutions.

- While effective for a segment of the market, Exosite's focus on OEMs means the vendor has less experience with and awareness of, the most common end-user requirements in the physical plant environment of industrial enterprises.

- Customers report limited usage and satisfaction with capabilities such as device management, and exhibit fewer examples of edge device control as compared with condition monitoring.

Flutura

Flutura's Cerebra IoT platform is a cloud-based solution that became generally available in April 2016. Cerebra is also available as an on-premises deployment. The company's strength centers on its analytics. Expertise in specific assets and processes reside in the Cerebra vertical-specific nano apps — a form of analytics-focused digital twin — that target specific IoT asset operational analytics (for example, in a drive motor failure). Analytics using Flutura's internally developed tools can incorporate a combination of interactive queries, expert knowledge rule systems, physics-based models, hypothesis testing and machine learning. The company also leverages partners for physics-based models as input to analytics capabilities. Flutura Cerebra visualizes results in an interactive chart and table format. Cerebra uses a Hadoop structure (in addition to in-memory store, document stores and other time series store variants for offline query capability), supports real-time streaming analytics and leverages a RESTful architecture to support API-based analytics queries.

Flutura's Cerebra Device Management Lite is a lightweight device management tool. For IoT edge messaging and communications, Cerebra supports protocols such as HTTPS, MQTT and UDP, and it has OPC connectors and programmable logic controller (PLC) drivers. It also provides configuration functions, such as factory reset and factory reboot and an over-the-air module for updates, and it will customize device protocols for provisioning and authentication. From an integration perspective, Cerebra leverages a standard API framework, open-source libraries, adapters for selected OT (for example, supervisory control and data acquisition [SCADA] and industrial control system [ICS] edge devices) and back-end applications (for example, field service management), as well as a framework to integrate with gateways.

Flutura targets Cerebra at three asset-intensive industries: specialty chemicals, oil and gas, and industrial machinery manufacturers. Flutura's indirect go-to-market strategy with partners like Microsoft and Hitachi is to act as a set of complementary software capabilities and integrate components to the partners' software. Its partner ecosystem includes Dell, Eurotech, Hitachi High-Tech Solutions (for system integration), Pricol, Microsoft (Azure cloud infrastructure) and the Jerry Allen Group. Despite its partner base, Flutura has limited IoT developer outreach.

Flutura is most active in the U.S. and Asia/Pacific — particularly India and China. Flutura has a growing installed base in Europe. Observed and verifiable IIoT use cases include remote monitoring to monitor, assess, predict and influence quality during manufacturing. They also include monitoring real-time parameters of operations and providing rule-based diagnostic alerts on abnormal activities of power generation plants. Tracking the operations and health of various assets in industrial sites, including diagnosis of mean time to repair and mean time to failure, is also included.

Strengths

- Flutura's Cerebra provides a broad range of analytical styles leveraging physics, heuristics and machine learning for industrial asset optimization and operations and management (O&M) with proven results.

- Flutura offers a track record of expertise and acumen related to the oil and gas companies as a sizable percentage of its installed base in that sector.

- Flutura's digital twin library, an extension of its IoT analytics applications, helps customers apply Flutura's technology to industrial asset maintenance challenges more quickly.

- Customers cite the ease of integration of Flutura's Cerebra into IT and OT enterprise applications for enhanced enterprisewide impact.

Cautions

- Flutura's future success requires the company to increase the number of successful partnerships with large IT and OT vendors to accelerate sales and expand its brand equity in industrial IoT.

- Flutura's device management lacks essential capabilities, and Flutura does not offer general-purpose integration (for example, for translation) or a device integration software development kit (SDK).

- Flutura's Cerebra is not audited and certified for compliance with ISO 27001.

- Flutura's Cerebra lacks natural language query processing and results generation.

GE Digital

Predix is an industrial IoT platform that links physical assets, aggregates sensor data with all other data sources, and analyzes data to provide business outcomes. Over the course of five years, the Predix platform has expanded through internal development, acquisitions (such as Meridium and Bit Stew), and partnerships (such as Microsoft Azure). GE Digital recently launched an on-premises solution named Predix Private Cloud, while integrating more application enablement capabilities into the platform to enhance its aPaaS capabilities. Furthermore, the Predix platform has a strong industrial go-to-market footprint through GE's business units and GE Digital's own direct sales force. Additionally, GE Digital maintains a reseller channel able to service and support customers around the world.

Since its inception, the Predix platform has evolved its go-to-market strategy. In December 2018, GE announced it is forming a new IIoT software company by merging GE Digital with GE Power Digital and GE Grid Software. The Predix platform is a combination of organically developed, acquired and curated OEM components. The organically developed components are the data asset models, analytic engines, Predix Private Cloud (on-premises solution), and data fabric (data ingestion). The acquired companies include Wise.io (machine learning), Bit Stew (data visualization) and Nurego (business operations). The curated OEM components of Predix are Microsoft Azure (public cloud), FogHorn (OEM providers of edge processing to Predix Edge) and Kubernetes (open-source container orchestration system for application deployment, scaling and management).

The future investment, development and innovation of the Predix platform remains in flux due to continued changes happening at GE Digital's parent, GE. With a new CEO (interim CEO currently as of this Magic Quadrant release) of a new industrial IoT software company, it is unclear what the future roadmap will entail. However, at this time, GE Digital continues its focus on its IIoT platform and industrial applications to support asset-intensive monitoring and automation, predictive maintenance, operations optimization, digital twin and other key industrial use cases.

Strengths

- GE Digital has a vast assortment of industrial experience and OT use cases in aviation, manufacturing, utilities/energy and oil and gas.

- Customers are very satisfied with Predix's software and agent release management for IoT and OT endpoints.

- GE Predix supports a broad portfolio of IT and OT SDKs for platform integration.

- GE Digital has a strong presence globally.

Cautions

- Uncertainty exists about the overall Predix platform product roadmap due to a series of changes to executive management and company structure and a continuously evolving go-to-market strategy.

- GE did not provide referenceable customers or sufficient technical documentation for its Predix Private Cloud on-premises solution.

- GE's use of different technologies (and development cycles) for its cloud-based and on-premises IIoT platforms requires increased costs and efforts to maintain skills, resources and tools to support diverse use cases and environments requiring cloud-based and sustained disconnected functionality.

- The viability of the newly created independent industrial IoT company is uncertain in terms of its business plan and business model, which is subject to change as it matures.

Hitachi

The Hitachi Lumada platform has been in production since May 2016. Over the course of three years, the Hitachi Lumada platform has seen developmental advancements to its edge and cloud integrations. With the recent acquisition of REAN Cloud (October 2018), Hitachi Lumada can offer different types of IoT-enabled cloud managed services, particularly to key target markets like smart cities and heavy industrials. Hitachi's Lumada platform offers a complete end-to-end solution that satisfies on-premises and cloud types of installation to asset-intensive industries like manufacturing,

transportation, energy and utilities. Furthermore, Hitachi has developed its rendition of digital twins called "Asset Avatars." Lumada Asset Avatars are considered low-fidelity digital twins as functionality is focused on asset monitoring and alerting features.

At the 2018 Hitachi NEXT conference, Hitachi Vantara shared its plans to extend the Lumada platform to support application-based outcomes with Lumada Maintenance Insights. Outside of its Lumada Maintenance Insights announcement, the predominance of Hitachi Vantara's major announcements were centered to its core portfolios, like the Virtual Storage Platform (VSP), Unified Compute Platform (UCP), Pentaho, and Hitachi Content Platform (HCP).

Hitachi has several selling avenues for Lumada, leveraging Hitachi Vantara and other Hitachi Ltd. subsidiaries, whether it be direct selling as an appliance, a software subscription solution, or as a service (early stages being offered). One of Hitachi's primary go-to-market strategies is to sell Lumada within its subsidiaries as a white-box solution embedded into the subsidiaries' product offerings. An example would be Hitachi Visualization Suite powered by Lumada's hybrid cloud and edge compute for smart city clients.

Strengths

- Hitachi can offer both a complete Lumada platform and a curated solution from various OEM providers to different asset-intensive industries like manufacturing, transportation, oil and gas, utilities, and smart cities.

- Integration tools and management capabilities are a leading capability for customers adopting Hitachi Lumada.

- Hitachi's Lumada has a breadth of industrial use cases that spans different vertical markets because of Hitachi Ltd.'s controlling ownership of several subsidiaries.

- Hitachi Vantara has several affiliations to developer communities, technology alliances and partnerships due to its industrial heritage and the previous relationships of Hitachi Data Systems, Pentaho and Hitachi Insight Group.

Cautions

- Based on the feedback of some customers, Hitachi Lumada may experience performance or functionality degradation if run on non-Hitachi-certified on-premises infrastructure.

- Despite Hitachi's marketing of advanced capabilities, the Asset Avatar is a low-fidelity digital twin that is a combination of a monitoring dashboard and thresholded alerting capabilities.

- Hitachi does not maintain a competitive value-added reseller channel for sales and services for Lumada, which limits the availability of sales and service resources.

- Hitachi lacks a broad and robust IoT edge device management capability.

IBM

IBM initially delivered the Watson IoT Platform in October 2014 as one of the many product offerings the vendor has released under the Watson branding. Watson IoT provides a comprehensive range of functionality for IoT spanning all key areas — application enablement, data management, analytics, device management, integration and security. Watson IoT is delivered as a collection of managed cloud services with the IBM Cloud. It can also be deployed on-premises via private cloud capabilities.

The installed base for Watson IoT spans a wide range of vertical industries across industrial, consumer and commercial enterprises. In the industrial setting, IBM can present example deployments in manufacturing, utilities, and transportation and logistics. Common use cases are predictive maintenance and asset monitoring. The industrial deployments are cloud-centric in nature, with no examples of completely on-premises implementations.

The Watson IoT Platform addresses extensibility requirements using the Node-RED open-source programming language. Customers use Node-RED to customize and extend the functionality of Watson IoT. Various reference customers developed custom services when the complexity of their requirements exceeded the capabilities of the packaged Watson IoT functionality.

IBM emphasizes the strength of its analytics and AI capabilities, which are at the core of its Watson strategy, as key differentiators for Watson IoT. Models for various types of advanced analytics, such as deep learning, acoustic analytics and computer vision, can be trained and deployed as part of Watson IoT to support various types of monitoring and predictive maintenance applications.

The Watson IoT Platform is best-suited for cloud-centric deployments across a range of use cases and environments. The platform leverages the diverse set of Watson IoT services and combines them in ways unique to the enterprise, as well as extending them or developing new IoT-related services, to make the platform relevant to most organizations. However, organizations should ensure they have the right resources available to address the development, configuration and integration requirements that come with more complex deployments.

Strengths

- The size and strength of IBM, general recognition of the Watson brand, and IBM's investments (such as marketing and IoT solution centers) in this space give IBM significant mind share.

- Watson IoT provides customers with a wide range of packaged functionality from which they can compose an industrial IoT solution.

- Most Watson IoT customers report a positive experience from their interactions with IBM's support organization, as well as the ability of IBM to provide strategic guidance in justifying, planning and delivering projects.

- The platform is based on Node-RED, which enables the customization of platform deployments and an ability to develop IoT-related services.

Cautions

- Watson IoT is a collection of software that requires significant overhead, in terms of development and integration, to recognize value as a complete solution.

- There are significant differences in the technologies and development cycles used by IBM for its on-cloud and on-premises IIoT platforms.

- Some customers express dissatisfaction with the lack of breadth of Watson IoT's supported analytic styles and say that creating analytic routines and data visualizations can be cumbersome.

- Some reference customers report a disjointed experience from IBM regarding how Watson IoT, Watson overall and IBM Global Business Services (GBS) are coordinating in the sale, implementation services and ongoing support of the Watson IoT Platform.

Litmus Automation

Litmus Automation's Loop IoT Platform launched in 2015 and 2016 and provides customers with a cloud and edge set of capabilities in its LoopEdge and LoopCloud products. Loop is a cloud-independent platform developed leveraging Litmus Automation, open-source software (OSS) technology and modules from partners.

Litmus Automation brings its customers an engineering-centric approach with a deep focus on manufacturing and industrial use cases. The firm's geographic focus to directly support its customers is North America, with partners such as JIG-SAW, Fujisoft, Tieto, Ciklum and AMAX working with customers in Europe, Asia and Japan.

A significant fraction of customers starts with LoopEdge the edge. LoopEdge provides the edge gateway, device management and connectivity, and cloud connectivity. It provides device drivers, message routing and a message broker, and local containers for apps and solutions. For the cloud, Loop is cloud-independent and can be deployed on the client's infrastructure providers such as AWS, Azure and Google Cloud Platform. While Loop provides the core IoT platform, it leverages Red Hat for the API portal and leverages Microsoft Azure or integrates to Siemens Mindsphere for digital twins. It also implements OMA Lightweight M2M device management and follows ETSI oneM2M and the IPSO Alliance. The solution has demonstrated integration into many different industrial devices (such as PLCs, robotic systems and computer numerical controls [CNCs]), and integration to software systems such as SAP, MongoDB and Tableau.

Litmus Automation has production customers in verticals including manufacturing, transportation and smart city. A significant portion of the customer use cases centers on leveraging integration and IoT data acquisition. Although Litmus Automation's IIoT platform spans the full range of required components for the industrial market, the company's strengths are focused on integration and application enablement for manufacturing applications. Observed and verifiable industrial use cases

include asset monitoring and predictive maintenance of in-plant manufacturing operations, and monitoring of industrial products.

Strengths

- Customers and partners are very satisfied with IoT device management capabilities and functions.

- Litmus Automation has proven market success supporting manufacturing customers.

- Litmus has strong proven ability to support customers for a full, on-premises deployment of an IIoT platform able to operate in a disconnected scenario.

- Customers cite price as a positive driver for adoption.

Cautions

- Only a third of customers leverage Litmus Automation's emergent analytics capability.

- The Litmus Automation developer community remains nascent and supported by limited on-site training, online training and support desk.

- While Litmus Automation has strength in manufacturing or automotive, it has limited expertise and engagement in sectors such as utilities or aviation.

- Some cite a lack of IT and OT system integrators that can plan-build-run solutions based on Litmus Automation.

Oracle

The Oracle IoT Cloud Service was made generally available in December 2015 and leveraged Oracle's broader platform as a service (PaaS) cloud offerings. The Oracle IoT Cloud Service integrates with both Oracle's middleware solutions and enterprise applications. Oracle's IIoT focus is on business applications rather than the underlying technology, emphasizing IoT asset monitoring, production monitoring, fleet monitoring and service monitoring. With out-of-the-box integrations to Oracle and third-party enterprise applications, including ERP, supply chain management (SCM) and customer experience (CX), Oracle positions IIoT as an IoT-enriched SaaS business application sale, rather than a PaaS technology sale. It targets its solutions at IIoT uses cases: asset monitoring, production monitoring, fleet monitoring and connected worker.

The Oracle IoT Cloud is a stand-alone solution that does not have any dependencies. A single SKU purchase of Oracle IoT Cloud entitles the customer to a complete solution. The solution consists of following: data management capabilities; IoT analytics; built-in integrations with maintenance management systems, enterprise asset management systems and manufacturing systems, among others; and domain-user specific user interfaces with custom dashboards and application

extensibility. Oracle customers also have the option to leverage other products from Oracle's portfolio, including business workflows, network management, and billing and revenue management.

Oracle's IIoT solutions can run only on Oracle Cloud but are available in an on-premises rendition via implementation on the Oracle private cloud. Several capabilities are available through partnerships. For example, Cisco's Control Center connectivity manager provides SIM support, and Wind River delivers Helix management for devices with the Wind River OS. Otherwise, Oracle leverages Telit for broader device management capabilities.

The Oracle IoT business unit has more than 250 developers and dedicated marketing, and its IoT solutions are sold and supported through Oracle's worldwide sales operation. Also, Oracle has partnerships with system integrators, such as Accenture, Deloitte, Hitachi, Infosys and Tata Consultancy Services (TCS). Observed and verifiable industrial use cases include asset monitoring and predictive maintenance of in-plant production operations, and in-field industrial assets, such as heavy industrial equipment and automotive fleets, all on cloud deployments.

Strengths

- Oracle's IoT application-centric approach to IoT offers faster implementation, ease of management and out-of-the-box connectivity to middleware and enterprise applications.

- Oracle bundles its middleware and cloud (including enterprise integration as a service) and its enterprise applications (including industry-focused MES, EAM and meter data management) to deliver end-to-end industrial IoT solutions.

- By leveraging Oracle Intelligent Bots, the Oracle IoT Cloud Service can provide natural language query processing and results generation as part of the broader data visualization and query capabilities.

- Oracle's IoT sales, marketing and support leverage the broader Oracle global operations and infrastructure to be able to deliver solutions in multiple geographies.

Cautions

- Oracle's IoT application-centric approach to IoT offers some reduced flexibility in favor of time to solution compared with a horizontal, self-directed IIoT platform.

- Oracle IoT Cloud provides device management capabilities for generic device management scenarios. Customers may need to rely on third-party device management solutions for specialized device management needs and certain types of industry-specific requirements.

- Oracle's IoT platform lacks a meaningful installed and related experience in the utility sector.

- The Oracle IoT Cloud Service is available only on Oracle Cloud, and it is not available on any third-party cloud services.

PTC

PTC's IIoT platform was built through the acquisitions of Axeda, ThingWorx, ColdLight, Kepware, and Vuforia. These acquisitions have been consolidated into a single platform, ThingWorx. It's worth noting the acquisition of Kepware and its OPC servers extended PTC's relevance to manufacturers' plant operations, while PTC's acquisition of Vuforia provided augmented reality (AR) capabilities. The 2018 acquisition of Waypoint may provide spatial context AR enhancements to ThingWorx.

ThingWorx delivers connectors to legacy PTC applications. PTC also maintains a marketplace that offers developers access to connectors and extensions to popular IT and OT apps and hardware. The platform is available as an on-premises deployment, and cloud and hybrid options, and it leverages, where required, existing cloud and IIoT investments in Microsoft Azure IoT Hub, AWS IoT and Rockwell Automation's FactoryTalk. In 2018, PTC also received a significant investment from Rockwell Automation.

ThingWorx's strength lies in its long experience with the assets across vertical markets and tends to focus on asset monitoring, predictive maintenance and asset utilization solutions. To develop these solutions and industry knowledge, PTC has developed a global ecosystem of IIoT-focused technology partners, solution providers and global system integrators. Finally, ThingWorx is one of the best-known IoT platforms in the market and continues to invest both in its visibility and in its developer community via its LiveWorx event, its marketplace and its developer portal.

PTC maintains a global sales force and an indirect channel of resellers worldwide. Observed and verifiable industrial use cases include asset monitoring and predictive maintenance of multiple in-field assets, such as automotive fleets and connected industrial products, and manufacturing operations, such as consumer packaged goods and electronics. PTC's weakest installed base of customers lies within the motor freight, energy, natural resources and utility sectors.

Strengths

- PTC supports approximately 40,000 developers via its ThingWorx ecosystem, supporting connected products and connected operations. PTC offers users foundational and advanced training and certification course work and programs.

- PTC has demonstrated strong R&D efforts such as expansion of digital twin functions, its support of industrial protocols, and the integration with Rockwell Automation's FactoryTalk Analytics.

- ThingWorx receives positive customer ratings for overall experience, integration and deployment, and service and support. Customers evaluated ThingWorx most highly for its integration, and application enablement and management.

- PTC has strong proven ability to support customers for a full, on-premises deployment of an IIoT platform able to operate in a disconnected scenario.

Cautions

- PTC's customers do not always leverage ThingWorx's analytics capabilities, and some customers using PTC's analytics expressed frustration relating to implementation and usability.

- PTC's digital twin is optimized for connected products, and it offers limited support to industrial owner-operators of industrial assets to apply digital twins to environments based on complex, heterogeneous IoT-enabled assets.

- Based on customer feedback, as well as customers in Gartner inquiries, PTC's pricing for its ThingWorx Enterprise Edition is often 20% to 50% more expensive than competitors for both cloud-based and full on-premises deployments.

- PTC still lacks a competitive installed based and related experience in the utility sector.

QiO

Launched in 2016, QiO Technologies' Foresight Platform is a cloud-independent industrial IoT platform developed leveraging open-source software (OSS) and OEM technology building blocks. A critical approach that QiO brings to its engineering-centric customers is its analytical digital twin for industrial assets, called PARCS, which stands for performance, availability, reliability, capacity and serviceability. QiO models, predicts and simulates the status of industrial assets, based on the PARCS policies and the state of the asset considered, against the cost and service requirements of the asset.

QiO has production customers in verticals including logistics, maritime, manufacturing, and oil and gas, although the preponderance of customers is aviation-centric working to increase O&M productivity in aviation-related examples. QiO provides sales, services and IIoT platform elements to industrial multinational corporations globally, although it is still building its market visibility. Strategic go-to-market partners include Rolls-Royce, Lloyd's Register, Globant, BT and PA Consulting.

Although QiO's IIoT Foresight Platform spans the full range of required components for the industrial market, the company's strengths are decidedly focused on advanced analytics with purpose-built application templates to enable customers to fast-track digital programs. The platform can integrate into, and span, IT and OT technologies; however, the Foresight Platform's capabilities in device management and OT technologies are still maturing to a level needed to compete with, or augment, legacy control systems. QiO is best-suited for manufacturers (such as for aviation products) seeking connected solutions for assets in the field and various use cases for supply chains associated with transportation and logistics. Observed and verifiable industrial use cases include asset monitoring, warranty management and predictive maintenance of in-plant mixed-mode manufacturing operations and in-field industrial assets, such as heavy industry, aviation and multimodal transportation.

Strengths

- QiO has doubled its connected IoT endpoint to a quarter million assets based on its industrial expertise and security and application enablement and management.

- QiO has proven industrial market success supporting IoT-enabled O&M improvements through advanced analytics, particularly for aviation owners/operators.

- QiO reinvests 60% of its Foresight IoT platform revenue in R&D. This supports its innovation efforts for its digital twin framework in the PARCS engine.

- QiO differentiated its platform — through application templates, as well as partnerships with third-party technology vendors — and offers a library of extensions, connectors and drivers to integrate assets and applications to integrate and augment OT.

Cautions

- Few customers leverage QiO's emergent, lightweight device management and data management capabilities.

- QiO is a small, emerging provider, and it requires partners to deliver the Foresight Platform and applications for global large-enterprise use cases.

- QiO's developer program remains nascent with selected customers centered on online training, tutorials and pairing with QiO developers for mentoring.

- QiO offers no meaningful installed base or experience within the utility sector.

ROOTCLOUD

ROOTCLOUD is one of the first IIOT platform providers originating from China. ROOTCLOUD is a startup company incubated by Sany Heavy Industry, which specializes in heavy machinery. Until recently, the company was marketed under the name Irootech. ROOTCLOUD has its headquarters in Guangzhou and its R&D centers and sales offices in major cities of China, including Beijing, Shanghai, Xi'an, Suzhou and Changsha, as well as Guangzhou. ROOTCLOUD currently employs over 450 people in IT and industrial IoT.

The two main platforms it offers are ROOTCLOUD Platform and ROOTCLOUD Edge. ROOTCLOUD Platform services about 500,000 high-value assets for real-time data collection, asset performance management, product life cycle management, intelligent services, big data analyses and AI. ROOTCLOUD Edge is an on-premises solution.

ROOTCLOUD Platform supports over 350 industrial protocols which enable connectivity to a series of PLCs, computer numerical controlled (CNC) routers, sensors, and special devices from OEMs, such as injection molding machines. The target market for ROOTCLOUD is the asset-intensive end users that specialize in heavy machinery and automotive. Its most prominent market penetration is the

China market with limited presence in Asia/Pacific and Europe, particularly in Germany, where Putzmeister, a manufacturer of concrete pumps, is one of its main anchor customers.

ROOTCLOUD is technically focused on API and protocol differentiators to integrate disparate industrial control systems (ICSs) within the industrial market. The usability of ROOTCLOUD Platform needs some further expansion to make it more diverse as it is currently predominantly focused on the manufacturing industry.

Strengths

- ROOTCLOUD has good support for API and protocol data integration to MES, ICSs and CNC machinery.

- ROOTCLOUD has support for over 350 industrial protocols that connect to a series of PLCs, CNC tools, sensors and special devices from OEMs.

- ROOTCLOUD Platform has many use cases and reference customers in the heavy industry and automotive subsectors.

- ROOTCLOUD has made headway into European markets through a signed cooperation agreement with key partners like Putzmeister, Munich Reinsurance and Telenor Connexion.

Cautions

- ROOTCLOUD Platform is not localized to a broader audience outside of the Chinese and English-speaking markets.

- Digital twins are a low-fidelity dashboard of monitored assets.

- ROOTCLOUD has very little experience or installed base within the utility sector.

- ROOTCLOUD currently supports only a single third-party (operating-system-independent) SDK for gateway integration.

Software AG

Software AG's foundational IIoT application platform suite, Cumulocity IoT, consists of Cumulocity IoT Core and Cumulocity IoT Edge. Together, the software provides device management, smart rules, cockpit, and preconfigured IIoT applications, and optionally integrated components such as real-time analytics, enterprise and cloud integration, and data and API management. The platform is available as either an on-premises or a cloud deployment model (including hybrid edge-cloud) and can be used stand-alone or in conjunction with Software AG's digital transformation portfolio. Data management, analytics and integration capabilities become available with such tools as webMethods, Trendminer, Zementis, Apama and Built.io.

The Cumulocity IoT platform has been built and developed by Software AG through several acquisitions, mainly of Cumulocity and webMethods products but also through other key capabilities, all which Software AG has "direct-developed." Furthermore, adopting a co-innovation approach to the portfolio of products and services, Software AG works on a release approach with new versions of the Cumulocity IoT platform every two weeks and major releases to customers every eight to 10 weeks.

Software AG has sharpened its focus on the IIoT marketplace by establishing a separate Digital Business Platform Cloud and IoT reporting segment. This accelerates the growth of the IoT business overall, and an IoT Center of Excellence as an overlay to the global sales team. In 2019, Software AG also introduced a separate business unit dedicated to IoT and analytics. In addition to its direct channel efforts, through its reseller channel of over 55 resellers, Software AG generates 50% of its IIoT platform revenue from these partners. These resellers include industrial players, such as the ADAMOS consortium, smart equipment/device manufacturers, telcos, system integrators and professional services that have white-labelled Cumulocity IoT.

Cumulocity IoT addresses both the owner/operator and maker-of-product approaches for IIoT platforms. The former approach is reflected in use cases with companies such as Nordex, Entrematic and SIAD; the latter approach is clearly reflected in use cases with companies such as Dürr and CERTUSS. In all cases, improvements in either operational efficiency or management of customer assets were achieved with the implementation of the Cumulocity IoT solution.

Strengths

- Customers are typically satisfied or completely satisfied with the overall experience with Software AG.

- Software AG supports 150 preintegrated devices spanning more than 350 protocols to enable the connection of a large range of industrial devices.

- Software AG offers strong cross-suite value, including data management, analytics and integration capabilities from Software AG's Digital Transformation portfolio in addition to its Cumulocity IoT offering.

- Software AG has established a dedicated IoT center of excellence (CoE) to drive its IoT business globally with a consistent go-to-market approach.

Cautions

- The Software AG solution handles a range of historians, such as Wonderware, PI Server and GE Proficy, yet still does not have full OPC UA protocol support, which may present a challenge for some customers.

- The Cumulocity IoT Edge deployment model is still being developed and tested for automated mass installation.

- The technical service and support of Software AG remains a point of dissatisfaction for platform customers.

- Software AG must improve how the company supports secure coding practices in terms of mandatory peer review and third-party code reviews.

Vendors Added and Dropped

We review and adjust our inclusion criteria for Magic Quadrants as markets change. As a result of these adjustments, the mix of vendors in any Magic Quadrant may change over time. A vendor's appearance in a Magic Quadrant one year and not the next does not necessarily indicate that we have changed our opinion of that vendor. It may be a reflection of a change in the market and, therefore, changed evaluation criteria, or of a change of focus by that vendor.

Added

Davra, Eurotech, Exosite, GE Digital, Litmus Automation, ROOTCLOUD

Dropped

SAP

SAP's IIoT platforms were dropped from the Magic Quadrant evaluation because the company ended its reseller agreement for IoT Device Management. Until recently, SAP sold a co-branded product from Telit named "SAP IoT Device Management by Telit." As SAP no longer offers IoT Device Management as part of its product catalog for cloud or on-premises deployments, the SAP IIoT platforms do not conform to the inclusion criteria.

Notable Vendors to Consider for IIoT

The evaluation process for the IIoT platform Magic Quadrant identified more than 40 vendors that were not included in the Magic Quadrant but that have forward-looking or specialized value for industrial enterprises. CIOs have myriad choices for their IIoT platform beyond the cohort of vendors evaluated herein.

It is important to note that the exclusion of any vendor from this market evaluation is not a de facto assessment that the excluded vendor cannot provide value to industrial enterprises. Exclusion is a function of nonconformance with the inclusion criteria, which are established based on Gartner's view of the evaluated market. Once the criteria are established, Gartner seeks to evaluate a set of vendors that are relevant and extensible to as many Gartner customers as possible. This evaluation of IIoT platforms focuses on a small number of providers that meet Gartner's inclusion criteria for this Magic Quadrant cycle. There are other vendors that merit consideration in any due diligence for

IIoT solutions. The following vendors are presented based on platform capabilities, experience with industrial enterprises and an ability to create related value.

ABB

ABB's Ability IoT offering includes a range of secure, scalable services and IIoT platform components required for industrial enterprises. The company did not meet the Magic Quadrant criterion for offering its platform as a stand-alone, salable horizontal IIoT platform.

Alibaba

Alibaba's IoT offering spans a range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for offering the platform for an on-premises deployment in addition to cloud deployment.

AWS

AWS' IoT offering spans a range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for offering the platform for an on-premises deployment in addition to cloud deployment.

Huawei

Huawei's OceanConnect IoT offering spans the range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for offering the platform for an on-premises deployment in addition to cloud deployment.

IoT.nxt

The IoT.nxt offering spans the range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for offering the platform for an on-premises deployment in addition to cloud deployment. Also, the company did not meet the required number of IoT endpoints under management.

Microsoft

Microsoft's Azure IoT offering spans the range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for offering the platform for an on-premises deployment (specifically, IoT Hub), in addition to cloud deployment.

Schneider Electric

Schneider Electric's EcoStruxure IoT offering includes a range of secure, scalable services and IIoT platform components required for industrial enterprises. The company did not meet the Magic Quadrant criterion for offering its platform as a stand-alone, salable horizontal IIoT platform.

Siemens

Siemens' MindSphere IoT platform offering spans the range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion in Gartner's estimation as it leverages services from multiple cloud providers and other partners in its offering.

Inclusion and Exclusion Criteria

To qualify for inclusion, vendors must conform to the following criteria:

1. The vendor must be a supplier of IoT software and IoT cloud services to asset-intensive industries with multiple accounts running the platform in production in at least two defined sectors. For this evaluation, Gartner identified the following sectors (and subsectors) as representing asset-intensive industries:

   - Manufacturing and natural resources (automotive, consumer nondurable products, energy resources and processing, heavy Industry, IT hardware, life sciences and healthcare products, and natural resources and materials)

   - Transportation (air transport, motor freight, pipelines, rail and water, warehousing, couriers, and support services)

   - Utilities (electrical, gas and water)

2. The vendor must be able to deliver and support, in a single bundled offering, the following capabilities across a distributed architecture:

   - Analytics

   - IoT edge device management

   - Integration tools and management

   - IoT data management

   - Application enablement and management

   - Security

3. The provider may include, via formal ongoing partnership(s) with other software vendors, a portion of the IIoT platform software functionality or platform components. The evaluated vendor must exhibit demonstrable value in terms of integration, scalability and interoperability relating to partnered solution elements. The predominance of the platform must be provided directly by the vendor.

4. The vendor has demonstrated a focus on industrial IoT technologies and solutions, and the general availability (GA) date for the IIoT platform must be 6 September 2018 or earlier.

   We also offered the following enhanced guidance relating to product releases.

   Product releases had to be in GA by 6 September 2018 to be assessed in the reference customer survey.

   Product releases occurring between 7 September 2018 and 30 October 2018 were considered, but vendors needed to inform us of all impacts of the release(s) at the RFP level (vendor survey) occurring within this window. Evaluation for impacted functionality would be based solely on analyst opinion.

   Product releases after 30 October 2018 would not be factored into scoring and would not impact dot positioning on the Magic Quadrant. However, vendors were requested to notify Gartner as soon as possible of any significant product releases planned for either December 2018 or January 2019.

   Major events, such as mergers and acquisitions, occurring after 12 December 2018 would be assessed on a case-by-case basis and might be included if the impact was significant enough to influence Magic Quadrant positioning.

5. The IIoT platform must be salable as a stand-alone offering and as an independent purchase without requirements for:

   - Companion hardware or software asset purchases

   - An existing asset base of vertical applications, software or hardware (such as maintenance, repair and operations [MRO], product life cycle management [PLM], APM, EAM, MES, distributed control system [DCS], ICS, SCADA and historians).

   For manufacturers, at least 10% of the assets under management by their IIoT platform must be outside of their own product lines.

6. The vendor has 20 paying customers. These customers must be from distinctly different companies with GA deployments in production.

7. The vendor must have at a minimum 100,000 IoT endpoints (see below) connected to its platforms across the installed base of customers (see Note 2).

8. The vendor must have multiple accounts running the platform in production in at least two of the following major regions (North America, European Union, Latin America, the Middle East and

Africa, and Asia/Pacific).

9. The product must be available as a cloud IIoT platform and as a full on-premises deployment (see Note 3).

10. The vendor must offer, directly or through partnerships, professional services (installation, implementation and integration) and support services (help desk, product support and sustaining engineering) in at least two major geographies.

Gartner Technology and Market Criteria for IIoT Platforms

Platform Deployment

Cloud services offer industrial enterprises an opportunity to increase the speed and reduce the costs of innovation. However, Gartner client inquiries reveal inertia in the market to adopt IIoT platforms based on concerns with the great number of IIoT platforms extended as *cloud-only* platforms. Feedback from many customers acknowledges that cloud-only solutions can demonstrate value for the analysis of operational data in cold stores. However, few cloud-only solutions are employed to address complex solutions spanning in-plant OT integration where the users require the IIoT platform to operate in scenarios that are disconnected (from the internet or public network services). A closer look at the deployment choices of industrial enterprises for enterprise applications, such as manufacturing execution systems (MES), enterprise asset management (EAM) and asset performance management (APM) makes it clear that on-site deployments are the overwhelming model.

The opinion expressed to Gartner analysts through numerous, intimate inquiries has made it clear that even if cloud-only IIoT is a corporate goal for the future, the initial use of IIoT solutions will require on-premises deployments. In fact, on-premises deployments are a growing requirement to learn and develop trust with IIoT platforms for the purposes of strategic consideration of IIoT platforms for corporatewide use.

Simply put, the culture of industrial engineers, while changing as IT and OT converge, places high trust in what they can touch and control. In addition, security and safety constraints dictated by regulatory agencies on asset-intensive industries, such as oil and gas and manufacturing, will often force companies to implement at least some of their industrial-focused IoT technologies on-premises for increased security and control. An on-premises deployment of an IIoT platform is the genesis of forming trust where IIoT platforms can add valuable data to Layers 3 and 4 of the ISA-95 model. However, IIoT platforms are increasingly being considered to augment — or replace — functions found in legacy industrial control and automation systems (ICAS) and human-machine interface (HMI) systems. To this very point, Gartner asked the references provided by the IIoT platform vendors if they chose their IIoT platforms as an approach to replace functions in ICAS. Twenty-one percent of the 132 respondents stated they will work to use IIoT platforms to augment ICAS, and 16% stated they will use IIoT platforms to replace ICAS functions.

The user references' feedback considered in this evaluation reflected the hedging strategies by industrial enterprises to test IoT on industrial data — but not necessarily within environments. Most investments for industrial IoT platforms that were adopted by the reference customers focused on the monitoring of a manufacturer's own products (consumer, commercial and industrial) or the monitoring of in-field assets with device-to-cloud architectures. Only a few vendors in this evaluation convincingly illustrated a portfolio of complex industrial use cases located in-plant that spanned IT and OT on a country-regional or corporatewide basis. Most use cases were one-off implementations relegated to a single piece of equipment, production line or plant.

Many of the initial case studies presented to Gartner were not in production and were proofs of concept (POCs) and extended field trials that never seemed to transition to plantwide or multiplant or corporatewide adoption. In fact, only 48% of the responding references deployed their IIoT platforms before 2018.

Gartner believes that 2019 and 2020 represent key years for the significant expansion of IoT platforms for industrial enterprises as both cloud and on-premises deployments. Our references in 2018 increased the use of on-premises deployments on IIoT platforms by 50% from the previous reference pool. Next year's references will likely exhibit the same increase in adoption.

IIoT Platform Offered as Horizontal, Stand-Alone Platform Offering

Platforms developed, marketed and sold by asset manufacturers only to existing or prospective customers of their industrial products and applications do not provide the broad value — and promise —of IoT regarding asset-independent extensibility and interoperability for operational and business value.

This criterion does exclude several very large and important manufacturers from this evaluation. However, the fundamental reason that interest in IoT is on the rise is its potential to break down monolithic sourcing and technology relationships — captured markets in "walled gardens" — to reveal value. Examples of value include reduced costs, increased production output and quality, and new business models.

Cloud Hybrid Versus Edge Versus On-Premises Deployments

The requirement for vendors to offer both a cloud and an on-premises deployment has given rise to further consideration of deployment options and design patterns around "hybrid" deployments. Hybrid deployments involve edge computing and the edge's connection to and reliance on cloud resources for updating, compute resources and long-term operations. Hybrid edge-cloud solutions are not considered on-premises deployments, because these solutions are unable to run in disconnected scenarios after provisioning and activation with cloud resources.

Edge computing is *the* battleground in industrial IoT between hardware vendors, software vendors, cloud vendors and an increasing number of edge-specific open-source solutions. The three main edge scenarios are as follows.

Hybrid Edge and Cloud

In this scenario, edge computing is on-premises. Services from the cloud (often containerized) are pushed to the edge for execution (for example, Microsoft's Azure IoT Edge). This includes such services as in-stream analytics, machine learning rules and AI rules. The cloud services maintain control and management, perform orchestration, create machine learning and AI rules, and support integration with other peer cloud services (such as business analytics and visualization) and with enterprise applications (such as ERP and MES). A hybrid edge-cloud solution for industrial IoT requires both the cloud and edge capabilities working together, and neither cloud capabilities nor edge capabilities can provide a complete IIoT platform solution on their own. A hybrid IIoT platform implementation does not meet the cloud and on-premises criteria outlined above.

Software Edge

The software edge is defined as being as close as possible to the sensor-enabled assets. The software edge is usually capable of executing analytics, machine learning rules and AI rules. The software edge may be provided by IIoT platform vendors or as an independent product by ISVs. Third-party partners include FogHorn Systems, Skkynet, Maana and Swim. In the latter case, it is likely to be a cloud-independent multicloud solution offering connectivity to a range of different cloud platforms and IIoT platforms. In some cases, the software edge will run:

- Remotely, in the cloud

- On far edge resources, such as an LTE base station (multiaccess edge computing)

- On the connected device (embedded or aftermarket) depending on device resources

- On an industrial IoT network gateway (that may also carry out such roles as network conversion, protocol conversion and data aggregation)

- On edge computing hardware (which may be on-premises represented by general-purpose computing, up to and including micro data centers)

- On legacy OT controllers or as part of emerging software-defined architectures for virtualized controllers

Hardware Edge

The hardware edge is defined by hardware vendors that offer on-premises compute platforms that connect to cloud-based IIoT platforms. These can vary from simple IIoT gateways to general-purpose compute boxes to on-premises data centers. The purpose of edge hardware is to offload services from the cloud in a distributed architecture and to run local on-premises services, where such issues as speed of operation and low response latency are important. The hardware edge often runs the software edge. While the hardware edge can be deployed colocated with IIoT cloud platforms, in most scenarios, the hardware edge is deployed on-premises. Edge-hardware-deployed capabilities do

not support the full IIoT platform capabilities (as would be the case with a full on-premises deployment). Hence, the hardware edge cannot exist in a disconnected scenario.

Evaluation Criteria

Ability to Execute

Gartner evaluates vendors on the quality and efficacy of the processes, systems, methods or procedures that enable IT provider performance to be competitive, efficient and effective, and to positively impact revenue, retention and reputation within Gartner's view of the market.

Providers are judged on their ability and success in translating market requirements — and their vision for the market — into products that match market needs and enable clients to achieve a successful outcome with minimal risk.

Product/Service

This criterion includes the core products and services that compete in and/or serve the defined market for IIoT platforms. This includes current product and service capabilities, quality, feature sets, skills, and so forth. This can be offered natively or through some OEM agreements/partnerships, as defined in the Market Definition/Description section and detailed in the subcriteria. The subcriteria for this evaluation criterion are analytics, IoT edge device management, integration, data management, application enablement and management, and security.

Overall Viability (Business Unit, Financial, Strategy and Organization)

Viability includes an assessment of the organization's overall financial health, as well as the financial and practical success of the business unit. This evaluation criterion views the likelihood of the organization to continue to offer and invest in the product. Additionally, this criterion works to understand the product position in the current portfolio and within the company's strategic view of IIoT. Ultimately, IIoT must relate to digital business strategy and the digital optimization and transformation of its customers.

Sales Execution/Pricing

This criterion includes the organization's capabilities for presales activities and the structures and tools that support them. This includes deal management, pricing and negotiation, presales support, and the overall effectiveness of sales channels. Gartner is especially interested in the sophistication and efficacy of the company's indirect channel to enable resellers, integrators and outsourcers of IT and OT to extend the company's platform to asset-intensive companies.

Market Responsiveness and Track Record

This criterion includes the vendor's ability to respond, change direction, be flexible and achieve competitive success as opportunities develop, competitors act, customer needs evolve, and

industrial IoT market dynamics change. This criterion also considers the vendor's history of responsiveness to changing market demands.

Marketing Execution

This criterion involves the clarity, quality, creativity and efficacy of programs designed to deliver the organization's message to:

- Influence the IIoT market

- Promote the brand

- Increase awareness of products

- Establish a positive identification in the minds of customers

This "mind share" can be driven by a combination of publicity, promotional, thought leadership, social media, referrals and sales activities. Gartner views successful engagement of developers, standards bodies, industry consortia and related organizations as key capabilities.

Customer Experience

This criterion includes IIoT products and services and/or programs that enable customers to achieve anticipated results with the products evaluated. Specifically, this includes quality supplier/buyer interactions, technical support or account support. This may also include ancillary tools, customer support programs, availability of user groups, service-level agreements, and so forth. Considered within this criterion are efforts to educate and transfer knowledge and insight to the market, including users, partners and the growing community of industrial-specific IoT developers.

Operations

This criterion involves the ability of the organization to meet goals and commitments of industrial enterprise customers. Factors include the perceived quality of the organizational structure, skills, experiences, programs, systems and other vehicles that enable the organization to operate effectively and efficiently. Investments in tools, support structures and marketplaces are considered essential elements in this criterion.

Table 1: Ability to Execute Evaluation Criteria

Evaluation Criteria ↓	Weighting ↓
Product or Service	High
Overall Viability	High

Evaluation Criteria ↓	Weighting ↓
Sales Execution/Pricing	High
Market Responsiveness/Record	Medium
Marketing Execution	Low
Customer Experience	High
Operations	High

Source: Gartner (June 2019)

Completeness of Vision

Gartner analysts evaluate vendors on their ability to convincingly articulate logical statements that appeal to, and support, industrial enterprises. This includes current and future market direction, innovation, customer needs, and competitive forces and how well they map to Gartner's view of the market.

Market Understanding

This criterion involves the vendor's ability to understand customer needs in asset-intensive industries and translate them into products, services, and market awareness and trust. Vendors show a clear vision of their market — listen and understand customer demands — and they can shape or enhance market changes with their added vision through the following:

- Product and service development

- Effective market conditioning and awareness

- Innovation spanning platform functionalities

- Business practices creating greater overall demand

Marketing Strategy

This criterion looks for clear, differentiated messaging consistently communicated internally and externalized through social media, advertising, customer-facing programs, partner programs and positioning statements to generate platform recognition and positive brand regard in the IIoT platform market.

It also includes the vendor's ability to either identify opportunities to expand adoption through geographic expansion or identify the underserved or poorly served market subsectors and unique business requirements through microsegmentation analysis and outreach.

Sales Strategy

This criterion involves a focused and structured strategy for selling IIoT platforms. The strategy identifies the appropriate channel mix, including:

- Direct and indirect sales

- Marketing and business development

- Direct and partnered service delivery (partner-led, co-delivery and private label)

- Supportive communication

Developing sales and value-added service partners and market alliances, all of which extend the scope and depth of market reach, expertise, technologies, services and their customer base, is a key consideration.

Offering (Product) Strategy

This criterion includes an approach to IIoT platform development and delivery that emphasizes market differentiation, functionality, methodology and features as they map to current and future requirements for asset-intensive businesses.

Business Model

This criterion includes the design, logic and execution of the organization's business proposition to achieve continued success in selling IIoT platforms to asset-intensive industries.

Vertical/Industry Strategy

This criterion involves the vendor's strategy and approaches to direct resources, skills and products to meet the needs of industrial market segments and industry subsectors within manufacturing and natural resources, utilities, and transportation and logistics.

Innovation

This criterion involves the direct, related, complementary and synergistic layouts of resources, expertise or capital for investment, consolidation, defensive or pre-emptive purposes to:

- Secure the trust and business of asset-intensive industries

- Apply IoT to internal operations

- Extend product capabilities and services into adjacent and new industrial use cases

Geographic Strategy

This criterion involves the vendor's strategy to direct resources, skills and offerings to meet the specific needs of geographies outside the "home" or native geography. This may be achieved either directly or through partners, channels and subsidiaries, as appropriate for that geography and market.

<p align="center">Table 2: Completeness of Vision Evaluation Criteria</p>

Evaluation Criteria ↓	Weighting ↓
Market Understanding	High
Marketing Strategy	High
Sales Strategy	Medium
Offering (Product) Strategy	High
Business Model	Low
Vertical/Industry Strategy	Medium
Innovation	High
Geographic Strategy	Low

Source: Gartner (June 2019)

Quadrant Descriptions

Leaders

Leaders invest in, and shape, the future of IIoT. Leaders perform skillfully and often exceed expectations regarding outcomes achieved with their technologies and services. The companies within the Leaders quadrant bring to market a stable IoT business unit and a cohort of lead executives with relevant IIoT experience that are aligned with the overall corporate strategy and vision.

Leaders have a clear vision of the market's direction. Leaders develop and bundle targeted competencies and capabilities that are expressed in sector-specific platform/suite functionalities to establish and maintain market leadership. Leaders consistently market and sell a complete IIoT platform as a single provider to any asset-intensive subsector for industrial use cases. Leaders offer services, capabilities and functions important to those markets they serve (for example, protocol and

regulatory support and conformance, where needed). The vision and execution of Leaders are evident in the platform's ability to integrate and interoperate with a broad and diverse installed base of industrial assets, endpoints, HMIs, and control and automation systems across different asset manufacturers and IT/OT ISVs. Differentiated functionality is provided through internal development and external relationships. These relationships include formal technology alliances and service delivery partnerships to facilitate broad, deep and frictionless integration and interoperability with third-party IT and OT hardware and software.

Leaders provide products and services, through internal development and acquisition and/or investment, which meet and expand the market needs of asset-intensive industries through innovation.

Leaders transfer knowledge to customers, partners and prospects through a library of sector-specific use-case frameworks and methodologies predicated on past performance. Leaders also engender trust by presenting numerous compelling and complex industrial reference customers and case studies in industrial environments to the market and to prospects.

Leaders are able to leverage IIoT platforms to augment and replace functions of legacy closed-loop control and automation systems. Leaders are also able to develop and market IIoT platforms that augment and replace industrial enterprise applications, such as MES, EAM and APM, through custom development or via marketplaces for connectors, extensions, microservices and apps. Leaders focus on providing a consistent set of technologies across cloud-based and on-premises deployments.

Leaders accommodate unique customer requirements with flexible engagement models and business development activities, as well as provide value across multiple geographies. Customer success and innovation are achieved by providing market-leading resources and tools, marketplaces and support to a large and active developer program focused on IIoT value-based outcomes. Gartner believes that active and participatory membership (code contributions and sponsorship) in multiple industry consortia and trade groups is required to not only expand IIoT and IoT, but also establish market leadership. This leadership is focused more on the development of market visibility and brand equity. It does not necessarily transfer to "de jure" platform leadership.

Leaders have the organizational size and scale to consistently pursue and win substantial multinational opportunities for IIoT. These opportunities are truly global in terms of supporting a referenceable customer base of multinational corporations (MNCs) that build their digital futures on the IIoT platform of the provider in at least four regions.

Challengers

Challengers are similarly influential in the future of IIoT. Challengers perform skillfully across multiple business-driven use cases and industrial subsectors, often meeting or exceeding expectations regarding planned outcomes achieved with their technologies and services. The companies within

the Challengers quadrant bring to market a stable IoT business unit and a stable cohort of lead executives aligned with the overall corporate strategy and vision.

Challengers are able to leverage IIoT platforms to augment and replace functions of legacy closed-loop control and automation systems. Challengers are also able to develop and market IIoT platforms that augment and replace industrial enterprise applications, such as MES, EAM and APM, through custom development or via marketplaces for connectors, extensions, microservices and apps.

Challengers focus on providing a consistent set of technologies across cloud-based and on-premises deployments.

Challengers have an emerging and coalescing vision of the market's direction. They develop competencies expressed more in adjacent, value-added application capabilities. Value-added capabilities include digital business, fleet management or use-case-specific analytics "applets," rather than end-to-end horizontal IIoT platforms/suites. Challengers choose a narrower path to sell their IIoT platforms to a targeted number of asset-intensive subsectors, rather than a broad cross-industrial focus. The vision and execution of Challengers are evident in the platform's ability to integrate and interoperate with a diverse installed base of industrial assets, endpoints and control systems across various manufacturers and IT/OT ISVs. The vision and execution are achieved through the creation of a limited set of formal technology and service delivery alliances. Such alliances enable integration and interoperability with third-party IT and OT hardware and software. However, these alliances are not considered best in class in terms of the ability to offer customers broad and deep value across asset manufacturers and IT/OT ISVs. Challengers provide products and services, through internal development and acquisition, that meet the generally competitive market needs of asset-intensive industries.

Challengers can transfer knowledge to customers, partners and prospects through a deep and broad library of sector-specific use-case frameworks and methodologies. Challengers engender trust by presenting numerous compelling, complex industrial reference customers and case studies in industrial environments to the market.

Challengers accommodate customer requirements with flexible engagement models and business development activities, as well as provide value across multiple geographies. Challengers invest in customer success and innovation by providing resources and tools, marketplaces, and support to a developer program. Gartner sees participatory memberships by Challengers in multiple industry consortia and trade groups for the expansion of IIoT and IoT.

Challengers have the organizational size and scale to consistently pursue and win substantial multinational opportunities for IIoT. These opportunities are truly global in terms of supporting a referenceable, customer base of MNCs that build their digital futures on the IIoT platform of the provider in at least three regions.

Visionaries

Visionaries have a clear view of the market's requirements and direction. Visionaries focus on providing advanced (in comparison to the general market), and often differentiated, value in targeted platform elements to meet the current and future market needs. Business value can take the form of technologies or business and operational models for complex industrial customers and use cases.

Visionaries focus on providing a broad continuum of value to meet future market needs and to effectively upsell and cross-sell within their installed base through trust and the extension of recognizable, iterative value. Visionaries expand their capabilities through acquisition, internal development and, increasingly, robust partnering. Visionaries need to improve their ability to meet customer expectations that address core operational intelligence, as well as integration with OT. Visionaries must work to extend market adoption through service delivery partnerships and technology alliances (for example, resell and OEM agreements). Additionally, Visionaries must work to expand their market focus through marketplace and developer community expansion.

Visionaries are able to leverage IIoT platforms to augment functions of legacy closed-loop control and automation systems. Challengers are also able to develop and market IIoT platforms that augment and replace industrial enterprise applications, such as MES, EAM and APM, through custom development or via marketplaces for connectors, extensions, microservices and apps. Visionaries focus on providing a consistent set of technologies across cloud-based and on-premises deployments.

Visionaries may have the size and scale to pursue and win large multinational opportunities for IIoT, but they tend to focus on one or two geographies for deep market engagement.

Vendors: Hitachi, PTC, Software AG

Niche Players

Niche Players focus successfully on a set of products and services and, often, focus on a narrow set of industry use cases. This includes focusing on the IoT platform for the purposes of supporting legacy or new applications and SaaS capabilities. Niche Players can show sales and marketing success in a limited number of industrial enterprises in regional markets or, often, dedicate only a portion of sales and marketing resources to newer, stand-alone IIoT platform opportunities

Most often, Niche Players tend to sell their end-to-end IoT platform capabilities to their larger, more loyal installed base — legacy "captured" customers — or as a bundled "vertical IoT" application platform or as a managed service. Niche Players are unable to exhibit much success in "greenfield" opportunities — without much of an existing relationship — for IT, OT and IoT integration. A key weakness of Niche Players is that they engage industrial enterprises, but they engage them in mostly "commercial" applications of IoT. Niche Players are unable to exhibit large-scale success and adoption of industrial use cases that span multiple plants, countries or regions. The narrower focus and successes of Niche Players may affect their ability to outperform or innovate. Niche providers

focus on providing cloud-first solutions and may have to offer separate catalogs of technologies for on-premises deployments.

Niche Players maintain a small installed base of complex industrial customers for industrial environments. They tend to focus more on in-field assets and use cases, where industrial enterprises interact with supply chain partners or commercial clients. Such use cases include connected commercial and industrial products by manufacturers, and meter and demand management by utility companies. Niche Players can be successful in a narrow selection of industrial use cases focused on a single market sector or subsector or single geography. Niche Players have difficulty expanding into alternative market industrial subsectors or upselling broader IIoT value to their installed base or new prospects. Even where Niche Players have off-the-shelf products aimed at industrial enterprises, Niche Players have been unable to take command as a leading force for IT/OT integration as an IIoT platform.

Niche Players are still very much viable providers of IIoT platforms.

Vendors: Accenture, Altizon, Atos, Davra, Eurotech, Exosite, Flutura, GE Digital, IBM, Litmus Automation, Oracle, QiO, ROOTCLOUD

Context

How to Use This Magic Quadrant

Gartner customers should not use this Magic Quadrant alone as a tool for vendor selection. This Magic Quadrant presents a new view of an emerging, highly hyped market. Our analysis and opinion are based on Gartner's unique ability to engage in user dialogue and to research the industrial enterprises across all subsectors and the vast landscape of competitive vendors. Gartner presents this modified and differentiated definition of the generalized IoT platform to reflect the segment of the IoT market where most of the high-impact, high-value investigation and net new adoption is taking place.

Because of this definition, historical comparison with existing Market Guides from previous years (to assess vendor capabilities) is strongly discouraged for projecting capabilities for industrial-specific use cases and driving bid opportunities for vendors not evaluated.

Readers should pay careful attention to the previous Quadrant Descriptions section to understand the qualities of each quadrant provider type and to determine the gaps between player types when considering vendor engagement. It is important to determine the most important provider attributes laid out in the Quadrant Descriptions section and align those with the enumerated Strengths and Cautions.

Given the lack of Challengers and Leaders in this inaugural evaluation, Gartner advises that platform due diligence, bid solicitation and selection decisions must be made in combination with analyst

inquiry engagement. Additionally, readers must keep up to date with forthcoming reference model documents and other IIoT-centric research.

For insight into vendors considered outside of this Magic Quadrant evaluation, see the Notable Vendors to Consider for IIoT section. Otherwise, consider this Magic Quadrant to be a summary of Gartner's current perspective and research on this market, with a focus on platforms for the IoT dedicated to asset-intensive industries.

Market Overview

Gartner has observed the following changes in the market and user behavior since the last Magic Quadrant for Industrial IoT Platforms.

IoT-OT Convergence and Virtualized and Software-Defined Control

For industrial enterprises, the unrealized promise of the industrial IoT is to marry the strengths of software-defined architecture, enhanced data acquisition, condition monitoring and superior analytics. Together, these combined offers will augment and eventually replace legacy control systems. In 2018, Gartner witnessed a large number of industrial enterprises investing in R&D for IoT solutions that extended the industrial IoT platform beyond the edge-gateway and onto the controller (or software-defined controller). These investments often include equity positions in startups. Additionally, increasing numbers of industrial enterprises seek to leverage the analytics from IIoT platforms as a feedback mechanism within closed-loop control systems.

Most encouraging was the vision expressed by this year's Magic Quadrant references. Reference customers for this Magic Quadrant were surveyed and asked to enumerate the reasons for adopting an IIoT platform. Of 192 references, 21% indicated that they will "*augment legacy automation and control systems*" with IIoT*,* and 16% stated that they adopted an IIoT platform to *"work to replace automation and control systems*."

Gartner believes that many industrial enterprises will be open to limited field trials for advanced IoT-OT convergence for distributed assets in the field, outside of core plant operations.

Managed IoT Services in Industrial Enterprises

Enterprises are becoming more and more educated on the value of IoT-enabled business solutions, from a perspective of both how IoT affects internal operations and how IoT extends externally to augment and support customer engagement. Achieving IoT-enabled benefits and outcomes requires an understanding of the broad set of requirements to pilot, scale and operate IoT solutions. To support this process, service providers are merging their IoT-related outsourcing and managed service capabilities into a hybrid managed IoT service offering. That is, more service providers offer services to manage the IoT solution design and selection process, develop the IoT solution, and provide the services to manage and operate the IoT solution.

The emergence of IoT outsourcing is important to original equipment manufacturers (OEMs) as they look to offer their products "as a service." Once the OEM has decided to change its business model away from selling its products as a one-time capital expense, an IoT outsourcing offering can expedite the OEM's time to market.

End-to-end managed IoT services encompass IoT edge hardware to the full IoT platform and related vertical applications. There are no examples of actual end-to-end managed IoT services that are extended to a user organization only as a recurring charge with no ownership of any assets by the user organization. That is likely to change as traditional outsourcers of OT environments look to apply IoT to their businesses.

Evidence

The fact base and evidence for the analyses within this Magic Quadrant are derived from several sources:

- Nearly 2,000 inquiries between Gartner analysts and industrial enterprises about industrial IoT from February 2018 through June 2019.

- Multiple primary research web surveys conducted in 2018. These surveys focused on IoT, and responses from respondents identifying their market sector as manufacturing, utilities, and transportation and logistics were isolated and analyzed.

- Gartner surveys of reference accounts provided by vendors in this Magic Quadrant. Across all vendors, Gartner's web survey was completed by 192 references. Additionally, Gartner analysts conducted separate telephonic interviews with at least 35 of these references.

- Vendor responses to an RFP to gather information relating to IIoT platforms.

Note 1
Operational Technology

Gartner defines operational technology (OT) as the systems used to control and operate the physical, non-IT assets of enterprises. These assets are involved in the event detection related to, and/or the control of, physical processes such as electricity, valves, machine tools, lighting or ambient environment.

Note 2
IoT Endpoints

An IoT endpoint enables equipment, assets or other objects to participate in one or more IoT solutions. There are three characteristics of an IoT endpoint when it is enabling an asset or object: (1) sense or activation capabilities; (2) compute (at a minimum data acquisition and control functions); and (3) communication. Gateways may have sense/actuation capabilities but must

provide some compute (even if this is fundamental message filtering and formatting) and communication.

Note 3
Hybrid IIoT Solutions

A hybrid IIoT solution requires both the cloud and edge capabilities working together. A hybrid IIoT platform implementation does not meet the requirements of the on-premises criterion.

Evaluation Criteria Definitions

Ability to Execute

Product/Service: Core goods and services offered by the vendor for the defined market. This includes current product/service capabilities, quality, feature sets, skills and so on, whether offered natively or through OEM agreements/partnerships as defined in the market definition and detailed in the subcriteria.

Overall Viability: Viability includes an assessment of the overall organization's financial health, the financial and practical success of the business unit, and the likelihood that the individual business unit will continue investing in the product, will continue offering the product and will advance the state of the art within the organization's portfolio of products.

Sales Execution/Pricing: The vendor's capabilities in all presales activities and the structure that supports them. This includes deal management, pricing and negotiation, presales support, and the overall effectiveness of the sales channel.

Market Responsiveness/Record: Ability to respond, change direction, be flexible and achieve competitive success as opportunities develop, competitors act, customer needs evolve and market dynamics change. This criterion also considers the vendor's history of responsiveness.

Marketing Execution: The clarity, quality, creativity and efficacy of programs designed to deliver the organization's message to influence the market, promote the brand and business, increase awareness of the products, and establish a positive identification with the product/brand and organization in the minds of buyers. This "mind share" can be driven by a combination of publicity, promotional initiatives, thought leadership, word of mouth and sales activities.

Customer Experience: Relationships, products and services/programs that enable clients to be successful with the products evaluated. Specifically, this includes the ways customers receive technical support or account support. This can also include ancillary tools, customer support programs (and the quality thereof), availability of user groups, service-level agreements and so on.

Operations: The ability of the organization to meet its goals and commitments. Factors include the quality of the organizational structure, including skills, experiences, programs, systems and other

vehicles that enable the organization to operate effectively and efficiently on an ongoing basis.

Completeness of Vision

Market Understanding: Ability of the vendor to understand buyers' wants and needs and to translate those into products and services. Vendors that show the highest degree of vision listen to and understand buyers' wants and needs, and can shape or enhance those with their added vision.

Marketing Strategy: A clear, differentiated set of messages consistently communicated throughout the organization and externalized through the website, advertising, customer programs and positioning statements.

Sales Strategy: The strategy for selling products that uses the appropriate network of direct and indirect sales, marketing, service, and communication affiliates that extend the scope and depth of market reach, skills, expertise, technologies, services and the customer base.

Offering (Product) Strategy: The vendor's approach to product development and delivery that emphasizes differentiation, functionality, methodology and feature sets as they map to current and future requirements.

Business Model: The soundness and logic of the vendor's underlying business proposition.

Vertical/Industry Strategy: The vendor's strategy to direct resources, skills and offerings to meet the specific needs of individual market segments, including vertical markets.

Innovation: Direct, related, complementary and synergistic layouts of resources, expertise or capital for investment, consolidation, defensive or pre-emptive purposes.

Geographic Strategy: The vendor's strategy to direct resources, skills and offerings to meet the specific needs of geographies outside the "home" or native geography, either directly or through partners, channels and subsidiaries as appropriate for that geography and market.

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