Magic Quadrant for Industrial IoT Platforms

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CIOs in industrial enterprises must cautiously approach IoT platform due diligence. Adoption is growing but the installed base of complex IT/OT integration is small and focused on narrowly defined outcomes. Focus on integration, and data and device management to ensure platforms scale with needs.

Strategic Planning Assumptions

By 2020, on-premises Internet of Things (IoT) platforms coupled with edge computing will account for up to 60% of industrial IoT (IIoT) analytics, up from less than 10% today.

By the end of 2022, the lack of compelling platforms in the market will induce 15% of manufacturers to develop or acquire IoT platforms, up from less than 1% today.

Market Definition/Description

Gartner defines the market for industrial Internet of Things (IIoT) platforms as a set of integrated software capabilities. These capabilities span efforts to improve asset management decision making, as well as operational visibility and control for plants, depots, infrastructure and equipment within asset-intensive industries. These efforts also occur within related operating environments of those industries. 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 safety, security and mission criticality associated with industrial assets and their operating environments. The IIoT platform software that resides on devices — such as, controllers, routers, access points, gateways and edge computing systems — is considered part of a distributed IIoT platform.

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 operational technology [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.

The IIoT platform differs from legacy OT (see Note 1) used in industrial environments for its ability to:

- Provide more cost-effective collection of higher volumes of high-velocity, complex machine data from networked IoT endpoints.
- Federate and orchestrate historically siloed data sources (such as, historians and enterprise asset management [EAM]) in industrial environments and on industrial assets. This enables better data accessibility for intraenterprise and interenterprise use.

- Improve insights and actions across a heterogeneous asset group through the specialized analysis of the centralized data.
- Offer improved application enablement and data visualization over legacy systems.

The IIoT platform monitors IoT endpoints and event streams, and supports and/or translates a variety of manufacturer and industry proprietary protocols. The IIoT platform also analyzes data at the IoT edge (near the asset) and in the cloud and data center. An IIoT platform integrates and engages IT and OT systems in data sharing and consumption, as well as enables application development and deployment. Increasingly, the IIoT platform is used to 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.

The IIoT platform, in concert with the IoT edge and through enterprise IT and OT integration, prepares asset-intensive industries to become digital businesses. The transition is accomplished by enhancing data availability and access for production and business stakeholders and with external business partners and customers, as required.

Horizontal and vertical business applications are out of scope for this Magic Quadrant. Examples include:

- EAM/computerized maintenance management system (CMMS)
- Fleet management
- Manufacturing execution system (MES)
- Maintenance, repair and operations (MRO)
- Product life cycle management (PLM)
- Asset performance management (APM)/condition-based maintenance (CBM)
- Field service management (FSM)
- Building management system [BMS]

However, the platform provider must exhibit demonstrable value regarding integration and interoperability with such applications.

Targeted Industrial Enterprises

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

- **Manufacturing and natural resources,** which includes 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 includes the subsectors of electrical, gas and water

Differentiating the IIoT Platform

The industrial Internet of Things is distinguished from general IoT in that IIoT technologies are focused and architected for use within asset-intensive industries (identified in the Inclusion and Exclusion Criteria section) 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:

- Advance 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 also may 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, MES, ERP, APM/CBM and EAM/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 both on-premises deployment requirements and 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. The volume of data generated by the endpoints, along with the frequency and velocity of data, is likely 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 significant savings.

Magic Quadrant

Figure 1. Magic Quadrant for Industrial IoT Platforms

Source: Gartner (February 2018)

Vendor Strengths and Cautions

Accenture

Accenture's Connected Platforms as a Service (CPaaS) is a hybrid, multicloud, stand-alone software platform. The platform has been generally available since 2015 and was developed by the Accenture Digital business unit. 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 and AMQP), data management and analytics. In August 2017, Accenture acquired intellectual property (IP) and assets from Exara, adding deeper edge data acquisition and management capabilities.

CPaaS spans the full range of required IIoT platform components for this market. The platform 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, or integrated with Amazon Web Services (AWS) and Microsoft Azure services.

Accenture prices CPaaS on a subscription basis and negotiates price points with customers based on the scope of deployment (number of connected assets), solution value and targeted predefined use-case outcomes.

Reference customer examples demonstrate CPaaS deployments in North America, Europe and Asia/Pacific. Vertical industries in the customer base include heavy industrial manufacturing, automotive, utilities, natural resources, and transportation and logistics. Deployments leverage Accenture's professional services for design, configuration and delivery of the solution, including customization of analytics and application functionality.

CPaaS is best-suited to organizations desiring preintegrated IoT services, managed delivery and deployment. The managed platform places an emphasis on data ingestion, analytics and visualization presentation for owners/operators with heterogeneous connected assets. CPaaS is an industry-agnostic IoT platform. 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 much technology or competency related to digital twins. 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.

Strengths

- Accenture excels in adapting to customer requirements for proofs of concept (POCs) and solution deployments by providing the requisite skills and resources to augment customer capabilities and engaging in flexible pricing and contract terms.
- CPaaS offers a broad range of platform capabilities and flexible platform delivery options, and the customization capability meets specific customer use cases and desired outcomes.
- Accenture's CPaaS received positive customer feedback in user reference surveys and interviews, and in Gartner customer inquiries relating to platform usage, ease of use and ease of integration. Accenture also received positive feedback relating to support and service.
- It has a broad business process knowledge across many vertical markets that is based on Accenture's long history as a professional services provider.

Cautions

- Accenture's CPaaS supports the interoperability standard OPC Unified Architecture (OPC UA); however, there are no production customers using the platform capability.

- Accenture lacks deep experience and capabilities in deploying CPaaS in mission-critical and regulated industrial settings.
- Accenture lacks a deep 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.

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. Datonis spans the full range of required IIoT platform components for this market, although Datonis is best-suited to organizations desiring a preintegrated, IoT platform suite focused on data ingestion and edge analytics. It is extensible and configurable for industrial production and business operations for specific customer needs. 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 is beginning to expand its presence into North America and Europe. Altizon's key OT partners include A&E Engineering, AWC, Bachelor Controls, Cotmac Electronics, Hargrove and Siemens. Additionally, Wipro is a key go-to-market (GTM) partner for Altizon.

Although Datonis is an industry-agnostic IoT platform, Altizon has targeted and proven capabilities in industrial asset monitoring and related analytics across automotive and chemical manufacturers, oil and gas, and utility companies with less than $10 billion in revenue. Altizon does not exhibit experience or strength via past performance in transportation and logistics sectors. 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

- Altizon's Datonis platform has demonstrated success within industrial enterprises for using IoT to augment and bridge IT and OT for industrial use cases.

- Datonis 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.
- Datonis Edge is built on the open-source Eclipse Kura gateway framework, which is the most well-known to industrial enterprises, and provides built-in support for industrial connectivity protocols, edge analytics and machine learning.
- Datonis is unique in that it provides to developers testing capabilities, such as simulators to generate devices, events, users and every configuration object in the platform. Developers also can test API integrations with other services and generate loads for scale analysis.

Cautions

- Altizon does not have a significant base of customers outside of India. The company is just developing a base of customers in the U.S. and Europe.
- Altizon lacks a productive indirect channel to market, which reduces the number of sources that are knowledgeable of Datonis and that are able to sell the platform.
- Datonis does not support the interpretation, transformation and handling of audio or video data.
- Altizon does not maintain a standardized security engineering framework and external auditing to provide customers assurances relating to secure platform development and testing processes.

Atos

Atos' Codex IoT leverages mature, well-established existing Atos middleware spanning Atos' internal business units (including Worldline, Worldgrid and Bull), as well as partnered and open-source technologies. The platform is available for both on-premises and cloud deployment.

The platform elements are based on many open-source technologies; however, there have been significant development and customization, and these elements are no longer considered open source. Codex IoT runs on Atos' cloud platform, and it is also available as an on-premises offering and for deployment on Microsoft Azure and AWS.

Atos does have experience and history working with asset-intensive industries, such as oil and gas, utilities, manufacturing, and transportation. The majority of deployments and references reviewed by Gartner focus on quality and predictive maintenance for industrial equipment, utility infrastructure and production line efficiency. The focus also is on connected car and fleet management services (fuel costs, driver efficiency and improved operations) for trucks, trailers and company cars.

Atos is most active in the European and North American markets. Atos' supervisory control and data acquisition (SCADA) business offers the company the requisite knowledge and acumen to pull Codex IoT into opportunities for utilities. For manufacturing environments, Atos is considered

best when focused on adding value to Siemens' assets within the manufacturing plant. Atos is able to support diverse manufacturers' products for the monitoring and management of assets in the field.

Atos' observed and verifiable industrial use cases are light in terms of companies leveraging the full Codex IoT stack. Most references and case studies offered for evaluation are focused on meter monitoring for utilities, and they include asset monitoring and predictive maintenance for OEMs to manage customer assets.

Strengths

- Atos' core business of enterprise IT services, platforms and industrial experience makes Atos a leading provider option for end-to-end managed IoT solutions.
- Atos has a focused IIoT platform GTM strategy predicated on legacy industrial control system (ICS) products, experience and industry acumen aligned with a significant partnership with Siemens.
- Atos maintains a substantial experience in the utility sector (spanning water, gas and electricity providers) for industrial automation and IIoT.
- Codex Connectivity Platform, a device and connectivity management element of Codex IoT, is a strong differentiator for clients that require secure, telematics-heavy IoT solutions.

Cautions

- Despite Atos' products for industrial enterprises, the company does not exhibit broad and deep penetration into industrial environments, where Codex IoT integrates into legacy OT (including ICS systems).
- End users that are averse to outsourcing the operation and administration of IT, OT or IoT solutions must consider that the Codex IoT platform is only offered as a managed service, in which all change management is controlled by Atos.
- Atos does not use channel partners or resellers to distribute the Codex IoT platform and managed services. The only alternative sales path is with a few industrial asset manufacturers (OEMs) that use elements of Codex IoT in their industrial solutions.
- Atos does not maintain a structured developer program, which limits access to third-party applications.

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. It leverages in-depth vertical industry knowledge with a broad technology portfolio. 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 particular type of 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. In addition to staffing in-house expertise, the company leverages partners for physics-based models as input to analytics capabilities. It provides customers with results visualization in an interactive chart and table approach. 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 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, SCADA and 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 heavy-asset industries: specialty chemicals, oil and gas, and industrial machinery manufacturers. It has a collaborative GTM strategy, with partners (Microsoft and Hitachi) having complementary software capabilities. Flutura integrates Cerebra components to the partners' software. Flutura has a limited IoT developer outreach program. Its partner ecosystem includes Dell, Eurotech, Hitachi High-Tech Solutions (for system integration), Pricol, Microsoft (Azure cloud infrastructure) and the Jerry Allen Group.

Flutura is most active in the U.S. and Asia/Pacific — particularly India and China. Flutura has a small but 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 expertise and acumen related to the oil and gas companies. This expertise is gleaned from 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 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 future success requires the company to increase the number of formal partnerships with larger IT and OT vendors to broaden its value potential to customers and prospects.
- Flutura's platform cannot enrich and supplement OT functions, as an extension of OT, for improved asset life cycle management strategies and processes.
- Flutura's Cerebra lacks data visualization and data query capabilities associated with analyst collaboration support, natural language query processing and results generation, and location intelligence.

Hitachi

Launched in May 2016, Hitachi's Lumada platform is developed and delivered by the Hitachi Vantara business unit — a recent reorganization and rebranding of Hitachi Insight Group, Hitachi Data Systems and Pentaho — as well as Hitachi Ltd. and other group companies. Lumada provides the full range of IIoT platform functionality, leveraging a combination of Hitachi technologies, and analytics and data management capabilities via its former Pentaho business unit.

Given Hitachi's experience and long history as a manufacturer of industrial equipment, the Lumada and related applications for rail, fleet management and asset management have been co-developed and deployed within many of Hitachi's operating companies. Both Hitachi Vantara and the Hitachi operating companies plan to sell Lumada globally across a wide range of industrial sectors spanning energy and utilities, manufacturing, transportation, and natural resources. The majority of deployments focus on improving operations and predictive maintenance.

Lumada can be deployed in a traditional on-premises model, as well as in the form of a hosted cloud service based on AWS, Google Cloud Platform and Microsoft Azure. Hitachi Vantara recently announced the Hitachi IoT Appliance, composed of Lumada platform software packaged with Hitachi hardware. The vendor continues to add sector-specific applications and functionality via a customer co-development process based on the concept of "solution cores." Solution cores are pluggable components that can be leveraged and personalized across customer deployments, addressing typical requirements, such as industrial asset monitoring, maintenance, scheduling, quality, safety and productivity.

Lumada is best for industrial environments involving Hitachi equipment, in which customers can leverage prebuilt Lumada functionality for edge device interaction and off-the-shelf solution cores

for application requirements. The company can provide value for multivendor assets, but due diligence is advised in terms of asset types and specific asset manufacturers. Observed and verifiable industrial use cases include asset monitoring and predictive maintenance of multiple manufacturing styles. Lumada brings to the market a focused expertise in visual quality monitoring. The platform also provides verifiable references for in-field industrial assets, such as heavy industrial, renewable energy generation, and fleet management for transportation and logistics.

Strengths

- The company provides experience in critical industrial sectors via sale and support of Hitachi equipment to end customers in those industries. This knowledge translates into reusable Lumada capabilities and faster deployments.
- Hitachi's emerging asset avatar concept fulfills digital twin functions for modeling and analytics, and it also enables software version control and release management.
- Hitachi offers robust edge capabilities that are purpose-built for manufacturing, utility and transportation asset environments.
- There is global presence, along with resources via the more than 100 Hitachi operating companies, as well as the global customer base of the former Hitachi Data Systems and Pentaho business units.

Cautions

- Hitachi does not maintain a generally available IoT marketplace for customers to access applications, extensions and connectors developed by Hitachi and third-party developers.
- The primary market served by Lumada is Hitachi's internal business units; therefore, there are limited proof points observed where Lumada adds value to non-Hitachi equipment.
- Prospects will find it difficult to find trained third parties knowledgeable of Lumada, as Hitachi lacks a deep and broad record of success for partnership programs for consultancies and system integrators.
- Lumada lacks a robust catalog of supported SDKs and the tools for secure management of software and edge agents.

IBM

IBM's Watson IoT platform was generally available in October 2014. The platform provides competitive capabilities for device management, analytics, data management, software development and security, and robust offerings for integration. IBM's Watson IoT platform is deployed as public cloud services (multitenant) and dedicated cloud (isolated and single tenant) for on-premises deployment. The platform's analytics capabilities leverage IBM's portfolio of analytics cloud services and open-source technologies, such as Spark and Apache Edgent.

IBM has demonstrated capabilities in IoT across manufacturing and utilities. The IBM Watson IoT platform also offers some specific solutions, such as IoT for Connected Services, IoT for Manufacturing and IoT for Automotive. Additionally, there are horizontal applications for asset management, asset performance, field service management and facilities management.

IBM's approach to knowledge transfer is solid, as the company leverages white papers, partner programs, technical education courses via massive open online courses (MOOCs) and various market engagement venues, such as trade associations and hackathons.

IBM provides the requisite services and IIoT platform elements to meet the needs of global multinational corporations in asset-intensive industries. The Watson IoT platform is sold by all business units in IBM, including IBM Cloud, IBM Analytics, IBM Security, IBM Sales and Distribution (S&D), and Global Business Services (GBS) teams.

IBM's Watson IoT is best-suited to organizations desiring to leverage IBM's middleware expertise, applications, its Watson stack and data centers located around the world for connected products and assets in the field, and various supply chain requirements of industrial sectors. Observed and verifiable industrial use cases include essential asset monitoring and predictive maintenance of in-field industrial assets, such as heavy industrial equipment, transportation and renewable energy generation.

Strengths

- The analytics capabilities within Watson IoT are easy to use and require less training than competitive platforms.
- IBM excels at using a consultative approach to identify customer issues and align technology and service investments to achieve outcomes.
- IBM maintains dedicated versions of Watson IoT in eight IBM Cloud data centers located around the world for global access to users in 175 countries.
- Watson IoT offers users flexible and diverse approaches to integration.

Cautions

- The references submitted by IBM did not demonstrate Watson IoT's appeal to, or capabilities for, the industrial domain to function as an extension of OT for production asset and process management.
- Watson IoT's success requires IBM to increase the number of formal partnerships with OT vendors to broaden its value potential to industrial enterprises.
- IBM's approach and investments for digital twins requires more evidence of capabilities and customer case studies when considering as part of a bid process.
- Multiple customers cite instances in which IBM has failed to fulfill on future platform functionality commitments.

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 (which it expresses as "IoTify your business applications"). 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. In particular, it targets its solutions at IIoT uses cases: asset monitoring, production monitoring, fleet monitoring and connected worker.

Oracle solutions depend on other Oracle services to build a complete end-to-end solution, including more sophisticated analytics, application development and workflow, 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 cellular/SIM device support, and Wind River (an Intel company) delivers Helix support for devices with the Wind River OS.

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). Jump-start programs include 30-day free trials and short duration POCs. 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 offers the market 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 is able to 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

- The Oracle IoT Cloud Service provides some basic device management capabilities but mostly relies on OEM-led device management solutions. Oracle's approach may require customers to support multiple tools for device management, depending on desired functionality.
- Although Oracle maintains a significant installed base for its other non-IoT technologies in the utility sector (for example, meter data management platform), the company offered no references for Oracle IoT Cloud Service deployments in that industry.
- The Oracle IoT Cloud Service is available only on Oracle Cloud, and it is not available on any third-party cloud services. The separately billable Oracle Integration Cloud Service may be used for integrating with non-Oracle applications.
- At the time of evaluation, Oracle did not support certificate authentication. Oracle has committed to support certificate authentication in an upcoming release.

PTC

PTC's IIoT platform was built through the acquisitions of Axeda, ThingWorx and ColdLight. These acquisitions have been consolidated into a single platform, ThingWorx. The acquisition of Kepware and its OPC servers for IIoT extended PTC's relevance to manufacturers from product management to plant operations. Additionally, PTC's acquisition of Vuforia for augmented reality capabilities has added to PTC's unique approach to digital twins.

ThingWorx is a complete end-to-end IIoT platform. It 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 option, and it leverages, where required, existing cloud and IIoT investments in Microsoft Azure IoT Hub, AWS IoT and GE Digital's Predix. To reflect the platform's cloud service security features, PTC has achieved ISO 27001 certification.

PTC's strength lies in its experience with the manufacturing sector based on its core applications for PLM, computer-aided design (CAD), service life cycle management (SLM) or application life cycle management (ALM) customers. Based on this experience, PTC tends to focus on asset monitoring, predictive maintenance and operational excellence solutions. To develop these solutions and industry knowledge, PTC ThingWorx continues to grow and nurture a global ecosystem of technology partners, solution providers and global system integrators.

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 manufacturing styles and in-field assets, such as automotive fleets and connected industrial products. PTC lacks an installed base of customers within the transportation and logistics, and utility sectors.

Strengths

- Manufacturers invested in PTC's PLM, CAD, SLM and ALM applications are well-positioned to leverage the natural synergies of ThingWorx IIoT platform when creating connected products.

- PTC supports more than 130 protocols via its KEPServerEX platform, which has connectivity to the ThingWorx platform.
- PTC offers users foundational and advanced training and certification course work and programs, including access to hands-on labs, as well as access to professionals focused on IoT platform integration, development or administration.
- The ThingWorx Marketplace provides more than 170 apps, extensions, starter kits and IoT products, and it helps nurture developer communities and their extensive ecosystem of partners.

Cautions

- Integration to enterprise systems is not native to the PTC ThingWorx IIoT platform, although integration is enabled through other third-party service providers, or through custom work.
- PTC's digital twin is designed for manufacturers of connected products, and it offers little support to operators to apply digital twins to environments based on complex, heterogeneous industrial assets and IoT devices.
- PTC's analytics are not easy to use or integrate, and they yield lower outcomes than planned.
- For MQTT support, ThingWorx Foundation requires either an extension from the ThingWorx Marketplace or an investment in an additional PTC IoT module or purchase of third-party cloud services.

QiO

QiO's Foresight Platform is a cloud-independent platform developed leveraging open-source software (OSS) and OEM technical building blocks. The Foresight Platform development started in 2015 and launched in June 2016.

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 two areas in which it leverages technology from partners on an OEM basis. The first area is in integration. The technology integrates with customer capabilities via OEM connectors from MuleSoft to connect with ERP and SaaS cloud systems and via Softing to integrate with MES and plant systems through OPC UA. The second area is in security. It leverages partners for a variety of features (for example, Tenable for penetration testing, NCC Group for external audits and Guardtime for distributed ledger capabilities).

QiO has production customers in verticals including aviation, maritime, manufacturing, and oil and gas. A significant portion of the customer use cases centers on leveraging IoT data acquisition

and advanced analytics 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. It has vital go-to-market partners, such as Rolls-Royce, Lloyd's Register and BT.

Although QiO's IIoT 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 applications to complete the platform. 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 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 proven success supporting IoT-enabled O&M improvements through advanced analytics for owners/operators within industrial enterprises.
- QiO has proven success for its capabilities for IoT application enablement and management.
- QiO differentiated its platform — through 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.
- QiO has best-of-breed partners in integration to enhance the technology stack.

Cautions

- Device management is a nascent platform element. QiO often engages partners to resell device management when customers require more functionality than is available on the QiO platform.
- QiO is a small, emerging provider, and its lack of execution for global marketing, sales and support limits Foresight Platform applicability for global large-enterprise adoption.
- QiO does not offer a structured developer program or a developer website for users.
- QiO currently does not support customers in the utility sector.

SAP

In 2016, SAP brought together its IoT capabilities under the Leonardo brand, committing $2 billion of investment over five years, and it incorporated acquisitions such as PLAT.ONE and Fedem Technology. Initially available on SAP's Cloud Platform, Leonardo is now multicloud, and it also runs on AWS, Google and Microsoft cloud services.

SAP is a supporter of Industrie 4.0 initiatives, and it adopts the reference architecture to address product-centric and asset-centric companies, as well as manufacturing, logistics, asset and service management. Leonardo is available as a stand-alone platform, but it offers more benefit with SAP's existing middleware and enterprise applications (for example, delivering connected products, connected assets and connected fleet). SAP has moved from selling IIoT as a technology platform to selling end-to-end solutions around enterprise applications, with defined business outcomes often associated with some form of digital transformation.

SAP Leonardo IoT and SAP's on-premises solution are based on different technologies with different development cycles. SAP Leonardo IoT is available only via the SAP Cloud Platform. SAP is able to provide customers a functionally equivalent platform as an on-premises, private cloud solution based on SAP and third-party technologies. SAP provides IoT solutions that can be deployed in the cloud and on-premises, and it offers IoT services, including device management, in-stream analytics, artificial intelligence (AI), machine learning, data intelligence and edge computing. The portfolio provides templates, design methodologies and a range of design and development tools. Digital twins are a fundamental part of the SAP approach to IIoT, and customers have leveraged digital twin capabilities.

Leonardo IoT is available through SAP and SAP partners worldwide, and also via OEMs to enterprise customers. SAP claims more than 1,000 partners globally, including system integrators and consulting firms — such as Accenture, Atos, Capgemini and IBM — and an ecosystem of independent software vendors (ISVs) and technology partners. SAP has certification programs for Leonardo to build further and strengthen its ecosystem.

While Leonardo IoT is an industry-agnostic IoT platform, it is best-suited to organizations with a significant SAP installed base that seeks an integrated solution spanning IT/OT integration, SAP's IoT applications, asset intelligence network and legacy industry applications. Leonardo IoT is appropriate for industrial asset monitoring and related analytics across manufacturing, utility, and transportation and logistics sectors. Observed and verifiable industrial use cases include asset monitoring and predictive maintenance of multiple manufacturing styles and in-field industrial assets, such as heavy industry and renewable energy generation.

Strengths

- SAP's experience in enterprise applications and middleware for manufacturing, and transportation and logistics markets provides a strong foundation of expertise for customers of SAP Leonardo IoT.
- SAP's IoT-specific acquisitions, investments and partner ecosystem demonstrate SAP's commitment to the IIoT market and the long-term viability of IoT within SAP and the SAP Leonardo product set.
- The ability to deploy SAP Leonardo IoT on multiple cloud services, such as AWS, Google and Microsoft Azure, as well as on-premises, broadens the flexibility and appeal of SAP's IIoT offerings.

- SAP Leonardo IoT offers proven capabilities to enrich and supplement OT functions with IoT for improved asset life cycle management strategies and processes.

Cautions

- SAP's use of different technologies (and development cycles) for its on-cloud and on-premises IIoT platforms will require significant increases in skills, resources and tools to integrate and manage hybrid IIoT platform deployments.
- SAP lacks a single point of ownership and efficient processes to provide customers timely support and expertise for issues with integrating or operating the platform.
- SAP provides cloud-based device management, but it relies on partners like Telit for on-premises deployments.
- SAP's IIoT offerings are heavily integrated with, and designed to pull through the sale of, other SAP cloud services and applications, limiting the appeal to industrial enterprises without a sizable SAP installed base.

Software AG

The foundation of Software AG's IIoT application platform suite is the Cumulocity IoT platform, acquired in March 2017. The platform natively provides capabilities for device management, data management and competitive capabilities relating to integration, analytics and security. Cumulocity IoT can be used stand-alone or in conjunction with other products in Software AG's Digital Business Platform portfolio to take advantage of improved analytics, data management and integration capabilities (for example, Apama, Zementis, Terracotta and webMethods).

In September 2017, Software AG entered a joint venture with DMG MORI, Dürr, ZEISS and ASMPT to create an open, nonproprietary Industrie 4.0 platform ecosystem and global alliance that consolidates IoT technology and industry knowledge. This venture — ADAptive Manufacturing Open Solutions (ADAMOS) — will enable engineering companies to test and certify IIoT-enabled solutions. ADAMOS uses the Cumulocity IoT platform, Apama and webMethods, as well as Cumulocity's set of IIoT apps.

Software AG has demonstrated capabilities across multiple industrial use cases for manufacturing, utility, and transportation and logistics customers. Software AG provides the requisite IIoT platform elements, and deployment models, to meet the needs of global multinational corporations in asset-intensive industries, particularly for owners/operators with diversified portfolios of industrial assets from different manufacturers.

Software AG maintains a competitive set of technology and service delivery partners. Software AG maintains the important sales, services and platform elements to meet the needs of global multinational corporations in asset-intensive industries for IIoT solutions. Observed and verifiable industrial use cases include asset monitoring and predictive maintenance of in-field industrial assets, such as heavy industry, automotive fleets and renewable energy generation.

Strengths

- Protocol support by the Cumulocity IoT platform is leading among vendors evaluated for manufacturer and enterprise application protocols, edge device protocols, and protocols supported by Cumulocity IoT-certified gateways.
- Cumulocity-based IoT solutions have the potential to benefit from other Software AG middleware symbiotically (for example, Apama and webMethods), and vice versa, which is a potential benefit for both Software AG and Cumulocity customers.
- Software AG offers a comprehensive IoT device life cycle management capability, including device health and connectivity management, in addition to secure device software release and change management.
- The Cumulocity IoT platform provides the capability to quickly create and use simple digital twins for asset state visibility.

Cautions

- Software AG lacks meaningful partnerships with OT vendors to convey any differentiated capabilities relating to integration with legacy ICS (on the edge) or enterprise applications, such as APM/CBM and EAM/CMMS.
- Software AG does not currently maintain a large customer base of IIoT platform solutions for core operations in manufacturing and utilities.
- Application enablement and management functionality is difficult to integrate and requires an investment in training for user proficiency.
- Software AG does not maintain a meaningful installed base of IIoT platform customers in Asia/Pacific, Latin America, or the Middle East and Africa.

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

This is the inaugural industrial IoT platform Magic Quadrant.

Dropped

This is the inaugural industrial IoT platform Magic Quadrant.

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 wishing to apply IoT to industrial use cases. 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.

Bosch Software Innovations

Bosch Software Innovations' IoT offering spans the full range of required IIoT platform components for industrial enterprises. The company focuses on consumer and commercial environments, and it did not meet the Magic Quadrant criterion for a sufficient installed base of industrial use cases.

Davra Networks

Davra Networks' IoT offering spans the full range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for a sufficient installed base of end-to-end solutions for industrial use cases.

Eurotech

Eurotech's IoT offering spans the full range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for a sufficient installed base of end-to-end solutions for industrial use cases.

GE Digital

GE Digital's Predix platform provides all required core capabilities for an IIoT platform for industrial enterprises with its cloud-based offering. The company did not meet the Magic Quadrant criterion for offering the platform as an on-premises deployment.

Microsoft

Microsoft's Azure IoT offering spans the full 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 full range of secure, scalable services and IIoT platform components required for industrial enterprises. Multiple on-premises and cloud solutions based on the EcoStruxure IoT platform are deployed globally across a broad spectrum of industries. The company did not meet the Magic Quadrant criterion for offering its platform as a stand-alone, salable horizontal IIoT platform.

Siemens

Siemens submitted its MindSphere version 2.0 IoT offering for consideration (MindSphere 3.0 became generally available earlier this year). MindSphere spans the full range of required IIoT platform components for industrial enterprises. The company did not meet the Magic Quadrant criterion for an on-premises deployment of the platform.

Inclusion and Exclusion Criteria

The following criteria must be met to qualify for inclusion:

1. The vendor must be a supplier to asset-intensive industries, with multiple accounts running the platform in production in at least four defined market subsectors in at least two sectors. Typically, business defined as "asset-intensive" align with the following Gartner-defined sectors (and subsectors):
   - 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
   - IoT data management
   - Application enablement and management
   - Security

3. The provider may include, via formal ongoing partnership(s) with other vendors, a portion of the software functionality or platform components. The provider 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 IIoT technologies and solutions, and the general availability (GA) date for the IIoT platform evaluated must be 17 August 2017 or earlier.

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

   - Product releases must be GA by 17 August 2017 in order to be assessed in the customer reference survey. Product releases occurring between 18 August 2017 and 16 October 2017 will be considered. However, vendors will need to inform Gartner of all impacts of the release(s) at the RFP level occurring within this window, and rating for impacted functionality may be based solely on analyst opinion.
   - Product releases after 6 October 2017 will generally not be factored into scoring and may not impact dot positioning on the Magic Quadrant. However, vendors are requested to notify Gartner as soon as possible of any significant product releases planned for either December 2017 or January 2018.
   - Major events, such as mergers and acquisitions, occurring after 1 December 2017 will be assessed on a case-by-case basis and may be included if the impact is significant enough to influence Magic Quadrant positioning.

5. "The industrial IoT platforms must be salable as an independent purchase without requirements for:

   - Companion IT and OT asset purchases
   - An existing asset base of IT and OT
   - The mandatory bundling of other value-added IT and OT applications, software or hardware (for example, MRO, PLM, APM, EAM, MES, ICS/SCADA and historians)."

6. The vendor has 20 paying customers. These customers must be from distinctly different companies with solutions being used in production. At least 10 customers must have demonstrated production GA deployments.

   - Manufacturers selling and marketing industrial IoT platforms must have 10 platform customers in production that are managing third-party assets.

7. The IIoT platforms of manufacturers must provide value for third-party (manufactured) business assets. At least 5% of assets under management by their IIoT platform must be outside of their own manufactured product lines.

8. Have at a minimum 50,000 IoT endpoints (IoT devices and gateways) connected to their platforms across the installed base of customers.

9. Have multiple accounts running the platform in production in at least two major geographies (in the North American, European Union, Latin American, Middle East and Africa, and Asia/Pacific regions).

10. The product must be available as both a cloud IIoT platform and an on-premises deployment.

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

12. The vendor must provide vision and insight into the role of digital twins, IoT testing and IoT system management, by way of existing platform capabilities, ongoing partnerships or a product roadmap for future functionality.

The Promise of IIoT

In asset-intensive industries, CIOs are called upon to support business strategies that require the elimination of data fiefdoms and silos by applying IoT technologies and principles to integrate IT systems with legacy OT. These diverse sources of information can reveal unknown issues and value, and enable new digitally enabled business models equally for manufacturers, utilities, and transportation and logistics companies.

The interest in, and adoption of, IIoT reflects the push by industrial enterprises to digitize their businesses. A digital business that requires contributions from industrial equipment, industrial plants and facilities, and relevant supply chains necessitates the integration of OT with IT systems and IoT.

It is important to note that IoT-enabled digital business by industrial enterprises may span industrial use cases as well as extend to commercial and consumer use cases. As an example, automotive OEMs applying IoT to internal manufacturing operations leverage IIoT while embedding IoT into finished goods to facilitate commercial and consumer services. Similarly, electrical utilities applying IoT to the power generation and transmission businesses leverage IIoT within the distribution and retail businesses for services such as meter data management and demand management (considered commercial and consumer/residential IoT). It is vital for industrial enterprises to consider extended opportunities, beyond IIoT, when conducting due diligence.

CIOs who do not act to investigate and to create digital business opportunities through the alignment and integration of IT, IoT and OT will cede growth in core markets and eliminate the possibility of extension into market adjacencies. Without investigation and investment in IoT, market leadership will migrate to agile new entrants and legacy competitors that move to create or acquire digital capabilities.

Gartner Technology and Market Criteria for IIoT Platforms

Platform Deployment

The requirement for vendors to develop, market and sell IIoT platforms deployed both in the cloud and on-premises is a controversial inclusion criterion for the first iteration of this Magic Quadrant study. What makes this criterion controversial is that it excludes a number companies that have created significant brand equity associated with IIoT. The criterion reads:

> "The product must be available as both a cloud industrial IoT platform and an on-premises deployment."

While cloud services offer industrial enterprises an opportunity to increase the speed and reduce the costs of innovation, Gartner client inquiries reveal inertia in the market to adopt IIoT platforms based on concerns with 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 and related enterprise applications, such as manufacturing execution systems and enterprise asset management. The opinion seems clear that even if cloud-only IIoT was a corporate goal for the future, on-premises deployments for extended field trials are a growing requirement to learn and develop trust with IIoT platforms. Simply put, the culture of industrial engineers, while changing, places high trust in what they can touch and control. An on-premises deployment of an IIoT platform is the genesis of forming trust.

The user references offered by vendors featured 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 production line or a single plant. Many of the initial case studies presented to Gartner were not in production and were POCs and extended field trials that never seemed to transition to plantwide or multiplant or corporatewide adoption.

Gartner believes that 2018 will see a significant expansion of IoT platforms for industrial enterprises as both cloud and on-premises deployments. Additionally, OEMs and vendors focused on industrial control and automation are expected to make an impact over the next 12 months as new deployment capabilities become generally available.

The Gartner evaluation team created this criterion. It mandated that vendors offer both cloud-based and on-premises-based deployments so as to offer CIOs the broadest IoT value proposition as CIOs set forth to appeal to diverse industrial enterprise personalities and internal stakeholders, such as CTOs and COOs.

IIoT Platform Offered as Horizontal, Stand-Alone Middleware Platform

The requirement for vendors to develop, market and sell IIoT platforms as asset-agnostic, horizontal middleware that is salable as a stand-alone offering was created to ensure broad availability and usefulness for industrial enterprises conducting due diligence. The criterion reads:

> "The industrial IoT platforms must be salable as an independent purchase without requirements for:

- Companion IT and OT asset purchases
- An existing asset base of IT and OT
- The mandatory bundling of other value-added IT and OT applications, software or hardware (for example, MRO, PLM, APM, EAM, MES, ICS, SCADA, historians)."

Platforms developed, marketed and sold by asset manufacturers only to existing or prospective customers of their 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 a number of 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 version of their IIoT platform capabilities and an on-premises implementation has given rise to a further consideration of deployment options and patterns around hybrid and edge computing. The requirement around cloud and on-premises is clear-cut, as described above. However, a number of vendors see blurred lines when hybrid and edge computing are considered in an overall offering. In particular, there is confusion around edge and on-premises, which are often terms used interchangeably, and often edge is considered to always be on-premises.

Edge computing is seen as the next battleground in IIoT 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 Cloud and Edge

In this scenario, edge computing is considered to be 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, 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 IIoT solution

requires *both* the cloud and edge capabilities working together: 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, and it may be provided by IIoT platform vendors or as an independent product by ISVs (such as Foghorn Systems). 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:

- In the connected device itself (if there are enough resources)
- In an IIoT network gateway (that may also carry out such roles as network conversion, protocol conversion and data aggregation)
- In edge computing hardware (which may be on-premises represented by general-purpose computing, up to and including micro data centers)
- In the cloud

The software edge can run in or at any tier within an IIoT end-to-end solution. The software edge is therefore not necessarily on-premises, and a software edge offering may not meet the criteria outlined above.

Hardware Edge

The hardware edge is defined by primarily 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 micro 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 the majority of 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 data center). Hence, the hardware edge cannot exist in isolation. As such, a hardware edge capability does not necessarily meet the cloud and on-premises criteria for this Magic Quadrant.

Consequently, a hybrid cloud solution and edge solution do not meet the criteria for an IIoT platform that must be available as both a cloud IIoT platform and a full and independent on-premises IIoT platform. Furthermore, neither a software edge deployment nor a hardware edge deployment will necessarily meet the requirement for on-premises capability — especially as neither can exist without cloud-based services to complete an implementation. Despite what we have seen from some vendors considered for this Magic Quadrant, the functional capability of

edge should not be confused with the deployment option of on-premises. It is important for users with on-premises platform requirements to fully understand these distinctions, as sales and marketing efforts often obscure such differentiation.

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 to translate 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, 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 as a function of its 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 supports 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 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 in order to influence the market, promote the brand, increase awareness of products and 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 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. 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
Sales Execution/Pricing	High
Market Responsiveness/Record	Low
Marketing Execution	Medium
Customer Experience	High
Operations	High

Source: Gartner (February 2018)

Completeness of Vision

Gartner analysts evaluate providers on their ability to convincingly articulate logical statements about current and future market direction, innovation, customer needs, and competitive forces and how well they map to the Gartner position.

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, externalized through social media, advertising, customer-facing programs, partner programs, and positioning statements to generate platform recognition and positive brand regard.

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 that 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); and 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 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 (sales, marketing, product, development and services), skills, and products to meet the needs of 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.

Table 2: Completeness of Vision Evaluation Criteria

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

Source: Gartner (February 2018)

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 broad, horizontal platform/suite functionalities to establish and maintain market leadership. Leaders can consistently market and sell a complete IIoT platform as a single provider to any asset-intensive subsector for industrial use cases. The IIoT platform of Leaders offers services, capabilities and functions important to those markets (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 and control systems across different asset manufacturers and IT/OT ISVs. Differentiated functionality is provided through both internal development and creation of an extensive set of formal technology and service delivery alliances 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.

Market Leaders transfer knowledge to customers, partners and prospects through a library of sector-specific use-case frameworks and methodologies predicated on past performance. Market 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 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 have an emerging and coalescing vision of the market's direction, and they develop competencies expressed more in adjacent, value-added application capabilities, such as 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, which 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 have a clear view of the market's requirements and direction. 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 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.

Niche Players

Niche Players focus successfully on a particular set of products and services, and a narrow set of industry use cases. Niche Players can show sales and marketing success in a limited number of industrial enterprises in regional markets, or a combination of all of these strategies. Most often, Niche Players tend to sell their end-to-end IoT platform capabilities to its 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. Namely, 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 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 as 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 for a select (smaller) number of use cases. However, users must be aware that broader IIoT expansion may not be possible with these providers. Currently, Niche Players neither maintain the broad and deep experience to develop and integrate into legacy OT, nor actively seek partnerships, acumen and scale from ICS vendors for broader market value and deeper industrial impact.

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 based on Gartner's unique ability to both engage in dialogue and 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 the majority of high-impact, high-value investigation and net-new adoption is taking place.

As a result 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 each player type 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 particular focus on platforms for the IoT dedicated to asset-intensive industries.

Market Overview

As the market for IIoT platforms matures, vendors will need to address not only a number of issues relating to platform capabilities and features, but also the competitive landscape to serve users better.

Few Middleware Platforms Are Complete, Organic IIoT Solutions

Most vendors rely on partnerships with third-party technology companies and open-source resources to improve or expand the functionality of their platforms. In the evaluation, we found no common platform elements that leverage third-party technology. Depending on the vendor, and their legacy business (if any), use of third-party technology spans identity and access management, data storage, API management, analytics, event processing, edge device agents, and the like. Any deployment of an IoT platform requires configuration and integration with operational and back-end systems and various sources of data to meet the requirements of the specific and planned IoT-enabled outcomes. The capabilities of an IIoT platform correspond to

various existing technologies and services, including integration, analytics, and control and automation, and the IIoT platform may require only the integration of multiple more-specialized platform technologies to improve or replace existing capabilities.

Any bid development and solicitation require an accounting of, and elaboration on, all underlying technologies as part of the discovery and decision process. That includes any elements that the vendor categorizes as organic or self-developed upon open-source resources, as well as understanding the depth and breadth of third-party technologies (for example, formal resale agreement and OEM agreements). Additionally, most of the more significant providers of IIoT platforms have extended platform capabilities through acquisition. Similar due diligence should focus on any investments made to the acquired software.

The IIoT Democratizes Asset Management

Industrial enterprises manage risk-based approaches to asset support and maintenance with a focus on identifying critical assets for CBM. Assets classified as nonessential operate on a "run to failure regime." Such prioritization depends on the impact of critical asset failure or the cost of the asset. It also depends on the expense to monitor an asset as a function of its value. IIoT platforms lower the costs to monitor and apply predictive maintenance to a broader and deeper pool of production and other assets. The approach is yielding significant results from avoidance of hidden costs associated with run-to-failure approaches. There are also other benefits, from considering "whole plant" monitoring regarding contributory factors to preventing production delays, such as deeper insight into the source of faults and incidents that contribute to a system's performance and availability.

The IIoT Platform Market Has a Device Management Problem

While there are specific and vital innovations when applying the IoT concept to business problems, most of the IoT technology "stack" is recognizable and has been in use for years in every IT environment. The real net-new technology addition to create an IoT platform is device management. Based on our evaluation of the vendors included within this Magic Quadrant, along with those vendors that submitted responses to our vendor survey, we deduced the following:

- Device management appears to be the technology element of the modern IIoT platform where vendors spend the least amount of effort and investment.

However, device management, while not a "strategic" concern for the IoT platform, is likely the largest tactical challenge for new deployments and investments in IIoT. An increasing and substantial line of inquiry from Gartner's industrial enterprise customers is determining whether an IoT platform can directly connect to, and manage, legacy OT. Legacy OT includes programmable logic controllers (PLCs), remote terminal units (RTUs)/main terminal units (MTUs), industrial connectivity services and the like. Alternatively, there are many users responsible for operations in industrial enterprises that do not believe that IoT solutions will ever supplement, or obviate, the functions of traditional industrial control solutions. Those users are correct today. Within the current generation of IIoT platforms, very few provide the functionality to directly

monitor and manage OT assets and devices with IoT platforms without significant integration challenges in terms of complexity and trade-offs relating to security. Most address device management capabilities through a gateway proxy into OT assets and devices, protocol translation, and a set of open SDKs for integration and device management communications.

In addition to vendors offering cloud-first and cloud-only IIoT solutions, the lack of extensibility of the device management function ultimately throttles the total addressable market of IIoT platform vendors, and it limits the total economic impact to industrial enterprises.

The IIoT Edge "Eats" the Cloud

In IIoT use cases, the velocity and volume of new data are too much for the typical enterprise's infrastructure to secure and process. Applying IoT edge computing and analytics, rather than traditional analytics capabilities, is quickly becoming the approach to managing data. An IIoT system processes diverse streams of high-volume and high-velocity data. In fact, Gartner predicts that, by 2022, there will be more IIoT analytics performed at the edge than analytics on "cold" data stores in the cloud.

The key performance considerations include analytics at the edge for resource-constrained use cases; latency concerns relating to industrial control and automation; safety and security concerns in closed-loop environments; and resiliency of the IoT system's contribution to operations.

Providers and Platforms Lack Approaches and Support for Standards

Based on the inclusion criteria developed for this first iteration of the IIoT platform Magic Quadrant, the evaluation is dominated by vendors traditionally serving IT requirements. While these providers have shown good vision regarding the capabilities of IoT platforms to meet some IIoT use cases, they did not demonstrate a deep understanding and support of industry standards to specific sectors or subsectors. In our RFP-style survey to the vendors, there was a minimal reference to platforms accommodating common standards that support IoT principles, such as AutomationML, MTConnect and PLCopen. Furthermore, there were no references to existing standards relating to international standards, such as:

- IEC 62443-4-1 (Product Development Requirements)
- IEC 62264-1 (Enterprise-control system integration)
- IEC 62443-4-2 (Technical Security Requirements for IACS Components)
- UL 9200-1 (Standard for Safety for Software Cybersecurity for Network-Connectable Products)
- ISO 55000 (Standard for Asset Management)

The list of standards for which manufacturers, utilities, and transportation and logistics sectors must consider in their engineering and operations is profound regarding numbers and

importance. Users will require templates and design patterns that adhere to relevant industry standards for their IIoT use cases.

Gartner views the acknowledgment and understanding of a broad array of industry-specific standards, as well as how those standards impact the adoption of IoT, as "table stakes" for leadership in IIoT. For this reason, Gartner believes that many potential Leaders in the IIoT platform market have yet to offer available products. Gartner believes that the potential Leaders for IIoT will be legacy OT incumbents willing to disrupt their installed base as they adopt IoT through partnerships, acquisitions and organic development.

Digital Twins Remain Big on Promises but Short on Value and Impact

Many providers of the IIoT platform present a spectrum of functionality that is called digital twin (alternatively named avatars or shadows). Gartner defines digital twin as "a digital representation of a physical asset that can be used to make decisions relating to the asset." The implementation of a digital twin is an encapsulated software object that mirrors a unique physical asset's characteristics. Critical elements that make a digital twin include a data model of the asset, an ability to monitor the state and attributes of the asset, and access to data from the asset to ensure a one-to-one representation of the asset. In short, the digital twin is applying established IT operations and service management principles to industrial assets.

Today, digital twins are customized and costly efforts for simple access to asset state data. Vendors tend to view digital twins as future salable companion software sold with each asset. That might be true in the short term; however, that is not a sustainable approach for users. Many industrial assets require some level of customization for the owner-operator. That means twins can naturally be generated as a function of design applications and other enterprise applications (for example, bills of material, invoices and orders). However, vendor-specific twins will likely require vendor-specific applications for the twins to add value. Such an operating model further exacerbates OEM-driven walled gardens.

IIoT must evolve to free owner/operators from OEM hegemony to pursue value-added applications that can generate digital twins independent of the OEM, as well as to allow digital twins to leverage third-party applications for enhanced capabilities. An example of such a capability includes the new human-machine interface (HMI) for control of, or the ability to simulate, current and future behavior of the asset.

Competitive Landscape for IIoT Platforms: A Fractured Market

There is no dominant provider of IIoT platforms. The market is crowded with a broad range of technology companies. The market is populated by small startups, large industrial players, system integrators and traditional IT companies all competing to provide solutions to industrial enterprises. Gartner expects many more vendors to enter the market, such as communications service providers (CSPs), and legacy industrial control and automation vendors.

This is the contradiction of this market. Legacy technology and service companies are slow to invest in corporatewide IIoT sales and marketing and delivery capabilities, but hundreds of

companies are marketing and selling IIoT as mature catalogs with mature support organizations to create demand. Although the vendors competing in the market are working to differentiate, most do so only in their messaging — but not in their feature sets and, as previously mentioned, deployment models. Examples of feature sets include broad industrial protocol translation capabilities, extensions, and connectors to OT and industrial applications. Additionally, Gartner sees large OT OEMs focused on extending platforms and applications for their products — but not for broad, multi-OEM platforms.

The most common providers of IIoT platforms in the market are as follows.

IT Vendors

Legacy IT vendors (for example, hardware, software and cloud services) have, over the past years, embraced the IIoT. These vendors tend to go to market focusing on their most significant industrial enterprises, positioning IIoT platforms as an upsell, value-added capability that creates an extension of the relationship. This de facto walled garden approach will enjoy short-term adoption in their largest and loyal customers; however, growth outside this installed base is doubtful, as development will be geared toward preintegrated solutions that do not encourage best-of-breed market selection.

- Areas of strength:
  - Connected product solutions with requirements for integration into IT front- and back-end systems
  - Ability to apply innovative approaches to data architecture and management across IT and OT sources
  - Ability to use analytical methods to data across IT and OT sources
- Example vendors: IBM, Oracle, PTC, SAP and Software AG

OT Vendors

OT vendors continue to emerge as potential vendors in the market for IIoT platforms. Their approach to IIoT is conflicted, as their core business is potentially obviated with the growth and adoption of IoT technologies by industrial enterprises. Gartner expects that OT vendors will continue to market next-generation OT, while also investing in, and acquiring, IoT technologies to prepare for the coming wave of adoption by industrial enterprises. To date, many OT vendors that traditionally focus on industrial data acquisition, control and automation have been slow to develop and market their own IIoT platforms. Gartner expects that once these vendors do market and sell available platforms and become more visible to the market, they will pose significant challenges to IT vendors, niche IoT providers and asset manufacturers that market and sell IoT platforms. Their full value in the market is anchored in asset and OEM independence, as well as their legacy values of safety and security that support conformance to industry and regulatory requirements.

However, the entry of OT vendors into IIoT is mostly as a hedge against disintermediation from the adoption of IoT technologies by industrial enterprises. Innovation by these providers may be slow and incremental because their primary challenge is to innovate while not cannibalizing their legacy installed base (with much less expensive technologies).

- Areas of strength:
  - Complex IoT, IT and OT alignment with robust integration with control and automation systems (or migrating some control and automation to IoT)
  - Ability to identify areas of OT suffering from functional obsolescence for cost-effective technology refreshment
  - Ability to understand how to prolong useful life of technologies
- Example vendors: Hitachi, GE Digital and Siemens

IoT Platform Specialists

IoT platform specialists go to market primarily on their IoT platform capabilities or a combination of platform and related edge devices. Most IoT platform specialists enter the IoT market focusing on a one-platform capability or two-platform capability relevant to IoT use cases. Application enablement and management, IoT device management, and analytics are the most typical core platform focus areas for entry into the market for IoT platforms. The market has exhibited a growing trust and tolerance for using smaller, more nimble IoT specialists. These providers tend to focus on a limited number of industrial use cases and industry subsectors.

- Areas of strength:
  - Ability to offer differentiated analytics from cold data sources
  - Ability to provide differentiated value relating to a few core subsector-specific use cases
- Example vendors: Altizon, Flutura and QiO

System Integrators

System integrators' initial approach to the IoT market has been to act as a knowledgeable source of technical expertise that can align with a user's desired business outcomes by integrating IoT technology within business processes. However, some system integrators are engaging the market as managed IoT service providers. Managed IoT services offer third-party management services delivered in support of parts, or the entirety, of a user's IoT solution. A provider's delivery of managed IoT services is enabled by cloud-based tools (such as cloud management platform [CMP], IT operations management [ITOM], IT service management [ITSM], and IoT monetization and skilled personnel observing structured processes in an operations center. The IoT technology

under management may be located on the customer premises, may be colocated or may reside within public and private clouds.

The key goal for managed IoT services is the optimization of service delivery through automated operational and administration activities (service automation). Optimization will improve IoT solution performance and availability, as well as support refreshment (release and configuration management) and utilization (access, provision, decommission and audit).

Increasingly, system integrators are creating their own centralized IoT platforms for value-added IoT services.

- Areas of strength: Ability to better align business outcomes and technical investments, to create connected product solutions with requirements for integration into IT front- and back-end systems.
- Example vendors: Accenture and Atos

Envisioning the Industrial Digital Mesh

The early focus in industry, and within Gartner, for the digital mesh [1] (#dv_1_top_10) has centered on consumer use cases and requirements. Examples of mesh-enabled business moments include customer engagement via connected products to strengthen brand affinities, such as for white goods, quick service restaurants, for proactive (automated) solicitation of offers or discounts that are context-bounded by customer actions or location. The power of the digital mesh, for both vendors and customers, is shared value created from participating in the digital mesh — vendors grow revenue (and maybe margin), and customers recognize the right value at the right time.

The models of companies such as Facebook, Amazon, Apple, Google, Tencent and Alibaba Group, along with their access to consumer information, naturally make them candidates to be the leaders of all things digital mesh.

However, industrial enterprises look to compete in the digital mesh based on their connected products; their access to consumer homes, commercial places of business and industrial customers; and their supply chains that connect them all.

Manufacturers are increasingly investing in IoT platforms to create "meshy" ecosystems around their products. Early examples tend to focus on consumer-type products; however, manufacturers of commercial and industrial products are investing in high-value monitoring and control solutions relating to their finished goods. Additionally, these manufacturers see opportunities to bend their business model toward IoT-enabled products as a service or dragging industrial assets into the "sharing economy." It is here where industrial manufacturers can create an ecosystem of partners to enable repair, information services (geographical information system [GIS], weather and location), supply chain and logistics information for replenishment of materiel required for fulfillment. Similarly, utility companies seek to take advantage of the ingress of power gas and water services to create IoT-enabled value-added services for consumer, commercial and industrial constituencies. Examples include building management and home automation, active

demand management, and managed energy (electric vehicle [EV], photovoltaic (PV), combined heat and power, power generation, and battery storage). [2] (#dv_2_iot_acquisitions)

Such expanded value-added services rely on connected solutions that leverage remote, and often automated control. Industrial enterprises looking to create IoT-enabled digital mesh solutions must consider the extensibility, or lack of, of any platform to enable value for core operations for consumer, commercial and industrial value-added solutions to customers beyond the plant.

Market Pricing Models

Market pricing models remain fluid for IIoT platforms, as many vendors view flexibility in pricing engagement as one way to reduce objections to purchasing. Key pricing methodologies in the market include perpetual and term license fees, subscription fees based on data, messages and other services, and bundled pricing for platform use extended on a per-device, per-month basis.

All of these pricing models have elements that tie to the number of assets, the volume of data, the length of the contract, the analytical output, the complexity of the environment and other criteria.

Gartner expects the adoption of managed IoT services to bend the traditional pricing approach to mandate pricing based on the quality of outcomes related to use cases, or other approaches to identify and avoid production delays. When outcome-based services are predicated on service guarantees, there will likely be lower costs to implement a solution and a higher likelihood of pricing contingency fees based on shared risk-reward expressed as a percentage of saving/improved productivity or fee multipliers.

Evidence

[1]"Top 10 Strategic Technology Trends for 2018"

[2]"IoT Acquisitions Accelerate the Creation of Digital Business Growth for the Industrial Sector"

Note 1
Operational Technology

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

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.