CONNECTING THE INDUSTRIAL MARKET: IS THERE AN APP FOR THAT?

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Industrial markets are increasingly becoming the target of IoT services. Equipment that is connected and monitored in real time helps production engineers avoid costly downtime. Analytics applied to this same equipment can be disseminated across the operations to not only detect signs of a failure event but plan service to maintain and/or replace without affecting operations. This same set of analytics can be used to create new products based on actual usage.

But industrial companies have been generally slow to adopt many new IoT technologies and services for a variety of reasons. One reason for reluctance has been the perceived security risks that arise when products are connected. Another reason is the complexity of choice across suppliers and technologies. Yet another is lack of internal resources to build or support IoT applications.

The supplier community has responded in multiple ways to these challenges, including development of IoT marketplaces and free trial offers. But another way that suppliers are responding is with ready-to-use apps targeting not only specific industrial markets, but also specific functional segments or roles within an organization. But an app is only the beginning of the journey to creating smart, connected operations, products, and solutions.

This white paper will provide insight on the primary industrial market segments seeking IoT solutions today. It will offer an overview of the technologies that are overcoming traditional industrial hurdles to IoT adoption as well as accelerating value. It will highlight the value of pre-built apps for industrial organizations, and conclude with an assessment of key capabilities for organizations to seek to create a long-term, sustainable, and cross-functional IoT operational capability.

MARKET SEGMENTATION

The definition of the "industrial" market can vary, but key markets include manufacturing, oil and gas, commercial transportation, and construction. But to understand the full IoT opportunity, a better segmentation places industrial markets into two distinct buckets: smart, connected operations, and products and solutions.

Connected operations are not defined by a single piece of equipment but by the processes that aims to produce something. The operation may rely on a few pieces of equipment that are considered key technology control points, or it can be a process defined by lots of simple equipment types that combine to create output. A good example is refineries that comprise long expanses of piping interspersed with distillers, evaporators, motors, and valves. Manufacturing lines are another example of both complex and simple equipment types integrated into a single production operation.

Monitoring and supporting operations processes are teams of people. Operations engineers oversee the day-to-day operational processes. They apply both operations and technical acumen to their area of responsibility to maintain production KPIs. Field service and maintenance technicians keep equipment maintained. Production supervisors monitor staffing levels and have overall production responsibilities. The common theme across all of these job functions is access to real-time operating data that provides tremendous value. What is different across all of these job functions is the specific data sets and backend systems they access.

The connected equipment market is more defined by the OEMs who design and make the equipment. Common examples of industrial equipment that has been connected include jet engines, locomotives, elevators, and mining machines. Much IoT focus has been on these complex industrial systems. However, there is an untapped part of the market that includes industrial subsystems such as motors, pumps, actuators, and tanks. These are the products that power many industrial operations.

The OEM market has similar functional groups as connected operations, such as field service technicians, product managers, and operations engineers.

Ultimately, applications that link to common backend systems are used by different functional groups to accomplish job responsibilities. When IoT data augments these applications, they become supercharged, offering real-time and predictive views on process and product operations.

DESPITE LEGACY INFRASTRUCTURE, THERE IS FULL IoT ECOSYSTEM SUPPORT

The toolsets to build applications are readily available to developers. The challenge is accessing and delivering the IoT data to create the apps. In addition, particularly in industrial operations, some key process touchpoints are not sensorized or digitized. Adding to the challenge is that more often, key touchpoints for extracting data leverage legacy and sometimes proprietary field bus protocols.

The very fragmented, diverse, and siloed industrial equipment market has not stopped technology suppliers from innovating to drive greater efficiencies on top of legacy infrastructure. Major areas of development have been in four key areas.

Connectivity: Data drives the value in applications, but connectivity facilitates data access. Industrial environments are notoriously hard to communicate in for a variety of reasons. Some industrial markets are very remote, such as the case in oil and gas wells. Others reside in very RF noisy environments. The other issue is legacy protocol communications into IP networks.

Wireless technologies have seen some of the most innovation and offer the most breadth in connectivity options and ROI relative to fixed-line connections. The newest Bluetooth technology—called Bluetooth 5—includes mesh networking capability to enable broader coverage. The other attraction of Bluetooth is its use in smartphones and tablets. More and more industrial equipment vendors are adding BT to their equipment to provide field service personnel access to stored operational data. Another technology that will facilitate major change in industrial markets is LPWA technologies. These technologies allow low-bandwidth communications on battery-powered devices across wide areas, similar to cellular technologies. LPWA technologies also have superior penetrating power for buildings and underground locations.

Device Data Accessibility and Transformation: Industrial markets comprise a myriad of device types powered by everything from traditional operating systems to RTOS and microcontrollers. Adding to this complexity are the field bus and industrial Ethernet communication protocols, which number more than 40 today. More common ones include Modbus, HART, and Profibus; however, even these only comprise 40% of all field device-type equipment.

Led by various standards bodies, new standards are in the pipeline for approval or dissemination into industrial products. The two most likely to ease communications between industrial equipment and Internet technologies are TSN and OPC-UA. OPC-UA, standardized by the IEC in 2011 and recently updated in 2015, is a vendor-independent protocol that allows diverse pieces of control equipment to communicate with each other, effectively enabling a hyper-connected network across multiple industrial ecosystems. The Avnu Alliance working group is driving development of the Time-Sensitive Networking standard, a low-latency industrial communications protocol that can interface and deliver data over standard IEEE 802 IT networks.

However, industrial equipment is known for its long life, so the new standards and benefits will take decades to have a broad-reaching impact. As this change occurs, there will still be a need for technology suppliers versed in bridging the gap between diverse hardware and software applications.

Advanced Analytics: Advanced analytics has traditionally been a cloud activity, but that paradigm is changing quickly to more use at the edge in industrial markets. The driver is the real-time nature of many industrial segments, such as the manufacturing and process industries that need fast response times to avoid catastrophic failures and costly unplanned downtime. Another benefit of edge

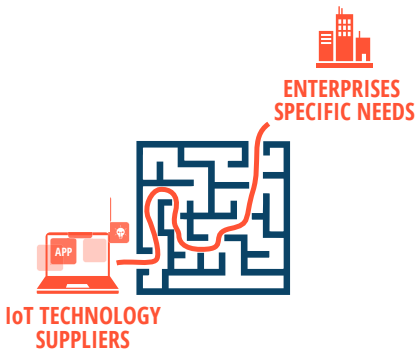
analytics is improved security. Security should always involve proper edge security mechanisms such as data encryption, but limiting payloads using edge computing improves the vulnerability profile. Edge intelligence can also assist in meeting legal and regulatory compliance requirements.

Overall, industrial markets gain the most benefits from advanced analytics executed both in the cloud and on the edge. Cloud analytics offer the best and most efficient means to examine large amounts of data and create and assess advanced predictive analytics models and prescriptive test environments. As well, advanced analytics functions built in the cloud allow creating sophisticated edge analytics functions that avoid issues of false positives and can assess the most up-to-date machine learning algorithms.

Augmented Reality: One of the most exciting new technologies to hit the market is augmented reality (AR). AR is the superimposition of data in the form of text, graphs, images, and even video, onto a live image of the physical world. AR applications are available today using smartphones and tablets. These same applications are being tested on smart glasses, and by 2021, ABI Research expects that more than 60% of AR apps will be viewed on smart glasses.

Field services employees in industrial markets will be one of the biggest beneficiaries of AR applications. Maintenance and repair workers can view maintenance history and service instructions without accessing other systems or calling home office personnel. Repair and installation tasks can be viewed as well, which, when using smart glasses, provides hands-free data access, greatly improving worker efficiency. Even more value is gained when IoT data, such as recent machine operating data and alerts, augment the AR application.

AR applications can also be used by production workers for creating digital workspaces for tool use, job tasks, and parts location. Overall, enterprise markets will be a primary user of AR apps, extending to doctors, nurses, firefighters, and other public safety markets.



WHERE TO START

More and more IoT technology suppliers realize that while their technology suite can serve multiple business units and market verticals, the reality is that enterprises buy based on their own specific needs. Technology suppliers also realize that companies want to work with suppliers with experience in their industry vertical and/or functional area. Bottom line, the breadth of the IoT solution covering both the IT and OT domains, in addition to the vast number of suppliers serving each part of the IoT value chain, has created one of the biggest obstacles impacting IoT solution adoption today: supplier diversity and offer complexity.

These market realities have driven verticalization in IoT. Verticalization can mean industry-specific solutions in parts of the value chain or complete end-to-end solutions. Examples of value-chain specific solutions are in data and analytics where the diversity of data, equipment, and process types by industry vertical drive more use of industry-specific solutions. End-to-end IoT solutions for specific industrial markets are common in segments such as connected fleets and home automation. These are two markets where there is a high addressable market and a complex device and supplier environment.

Verticalized solutions can be a very viable and prudent strategic choice for enterprises. A verticalized solution addresses an immediate need with a dramatically faster time-to-market regardless of the market type—OEMs or process industries.

When the vertical solution addresses all components of an IoT solution, from device to services, there are additional benefits. The enterprise can deal with a single supplier for all aspects of the solution rather than multiple suppliers. A single verticalized solution poses far fewer integration challenges compared to solutions assembled from multiple suppliers. A single verticalized solution can also have security advantages because each component has been tested and tightly coupled. Finally, enterprises new to IoT typically need time to understand the impact of the connected product or process on their operations both internally or externally. For some enterprises with a low risk profile, this testing period can be years.

OPTIMIZATION OPPORTUNITIES

THE FUTURE

But there is a flip side to relying on a single supplier, particularly with an end-to-end solution. If the supplier requires use of only its connectivity equipment, then lock-in can mean lost optimization opportunities. Enterprises using a single supplier are also dependent on the supplier innovation roadmaps, which may lag new innovation available in the broader IoT ecosystem.

One of the biggest risks with verticalized solutions is lost scale opportunities. There are two primary risks. First, many enterprises may have standardized around certain data center assets and cloud infrastructure. If the verticalized solution requires using the supplier's cloud, enterprise storage and compute assets are not fully utilized. Second, applications that benefit from connected assets will continue to grow as new machines types are connected and new functional groups are given access to insights generated from IoT data. Scalable IoT application development requires that the data ingestion and normalization functions are based on a common set of toolsets.

Verticalized solutions may not be the wrong choice depending on the market and need. But a better long-term choice is solution providers who offer pre-built apps but based on a horizontal set of tools that allow extending the enterprise IoT footprint to multiple work functions and machine types. Key horizontal toolsets that offer flexibility and scalability for development of IoT apps include the following:

- **Data Ingestion**: There are common tools used by applications for IoT data ingestion including MQTT, JSON, and WebSockets. However, as noted earlier, in many industrial markets, data types and protocols must be translated for communications on IP networks. Platforms that offer transformation software and services without sacrificing ingestion capacity are an added benefit for any horizontal platform attempting to serve legacy infrastructure.
- **Data Orchestration and Integration Services**: Data orchestration includes the ability to write complex business rules to act on data based on thresholds, geofencing, and other factors, and then direct the data to users *via* the preferred device but also to systems that draw insights from the data. For all industries, key systems consuming IoT data are ERP and CRM systems, but increasingly product catalog and CAD systems are consuming IoT data to further shape context around a particular part, product, or machine.
- **Analytics**: Analytics in a horizontal platform comprise various visualization tools to review static data sets, particularly those based on business rules and event data. Becoming more necessary, particularly in industrial markets, are tools that allow monitoring and detecting patterns in real-time data. The most advanced capabilities are predictive analytics functions. Predictive analytics are a bonus of any horizontal platform because it typically requires some sophisticated automation functions to efficiently identify and optimize machine learning algorithms regardless of the product or process monitored.

- **App Development**: An under-appreciated aspect of IoT is that not all apps require heavily customized code created from programming in Java, C++, or other common programming languages. What is more important is a rapid development capability based on templates, metrics, alert functions, and key system APIs to quickly equip a broader employee base with IoT data including product development, procurement, field service, facilities personnel, and mid-level management. Rapid development tools provide both expansion and upgrades to applications on a continuous basis.

ThingWorx 8

ThingWorx is a recognized leader in IoT services, and its recent release, TW8, provides new platform features to help developers quickly and easily build and deploy IoT apps and augmented reality experiences for industrial markets. First, using its Kepware assets inside ThingWorx Industrial Connectivity, industrial device data can be directly accessed inside of the ThingWorx platform faster than ever before. Within minutes, data directly from PLCs can be sourced and connected directly into the ThingWorx ThingModel. Next, more analytics functionality can be directly accessed into TW apps, such as anomaly detection on real-time data streams. A third new capability is AR applications for Microsoft HoloLens that can be natively developed directly in the TW Studio, further expanding the capabilities of ThingWorx for enterprise application development. Finally, ThingWorx8 has expanded cloud interoperability to the AWS, Microsoft Azure, OSIsoft, and GE Predix clouds, providing enterprises with more choice for building IoT apps and storing IoT data.

The other important addition in the TW8 release is the first set of pre-built apps for manufacturers. They include ThingWorx Controls Advisor, Production Advisor, and Asset Advisor apps designed for controls engineers, production advisors, and maintenance personnel. These are the first of many more role-based apps that PTC is launching on its scalable industrial IoT platform to ease choice, reduce costs, and speed time-to-market in a rapidly growing IoT market.

SUMMARY

Behind the few companies that are aggressive in IoT with multiple deployments is a huge base of companies either still evaluating their IoT options or in a limited market rollout. Holding back full-scale deployments for these companies has less to do with technology limitations and more to do with the broad choice in technologies and suppliers to build IoT applications.

IoT suppliers are overcoming these barriers by offering pre-built apps designed for certain vertical markets and/or specific functional groups. These apps remove from enterprises the long process of selecting individual suppliers for solution assembly and allow organizations quick time-to-market to start building their IoT intelligence.

In the longer term, scalable solutions will drive IoT success manifested in horizontal toolsets that can be used to build IoT apps that extend to any machine and any functional business unit or employee. When industrial markets are targeted, additional capabilities can drive long-term value in an IoT platform. These features include data ingestion technologies to overcome legacy protocol barriers, and advanced analytics functions that can be built into applications for real-time monitoring and predictive analytics. Overall, suppliers that can offer pre-built vertical or functional IoT applications created using extendable assets offer the fastest route to market with the added benefit of long-term scalability.

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