REPORT EXCERPT

PREVIEW

2018 Trends in the Internet of Things

DEC 2017

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2017 proved to be a transformative year for the Internet of Things, with new product categories, accelerating standardization efforts, widespread adoption in both horizontal and vertical use cases, and a multitude of vendor partnerships aimed at bridging the operating technology/IT divide.

THE FOLLOWING IS AN EXCERPT FROM AN INDEPENDENTLY PUBLISHED 451 RESEARCH REPORT, "2018 TRENDS IN THE INTERNET OF THINGS" RELEASED IN DEC 2017.

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REPORT EXCERPT

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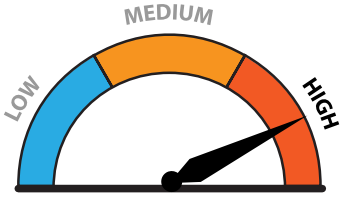
Trends

TREND 1: IOT ADOPTION WILL CONTINUE TO GROW ACROSS ALL INDUSTRY SECTORS, BUT FOR DIFFERENT REASONS

Implication: *Connectivity and analytics capabilities are now 'the new normal' for industrial and enterprise equipment, with lack of these abilities considered a competitive deficiency. There is now a sense of inevitability that all products and processes will be digitally enabled, which will unlock new productivity gains, cost savings and business models.*

Impact to the Market



451 Research's quantitative surveys of enterprise IT buyers, operational technology users and consumers all show growth of IoT adoption within datacenters, factories, fleets, homes and cars. While some of this adoption is greenfield, with new equipment purchases when industrial equipment is refreshed or when consumer home energy efficiency or security is upgraded, the majority of the adoption is still in the 'brownfield' retrofit market. This ranges from datacenters, some of the most heavily instrumented environments, to operational settings such as buildings, field equipment, vehicle fleets and factories (see Figure 1). These retrofits are driven first by bottom-line cost-savings goals in optimizing operations, as well as reducing risk and improving worker safety, with the goals of developing new 'digital' products or using IoT to help target customers for sales and marketing activities as a secondary goal (see Figure 2).

Figure 1: Three-Quarters of Enterprises Have IoT Efforts Underway

Source: 451 Research's Voice of the Enterprise: Internet of Things, Organizational Dynamics 2017

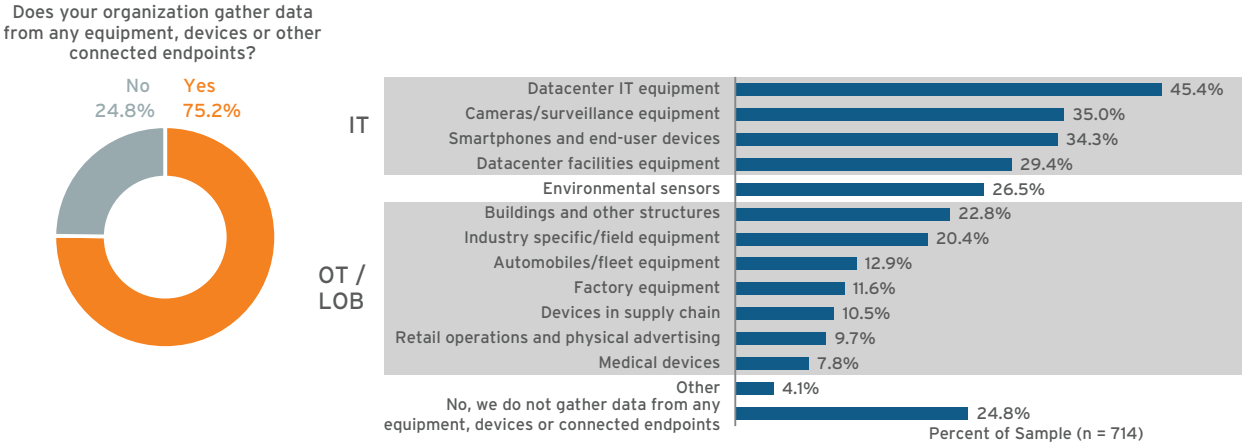
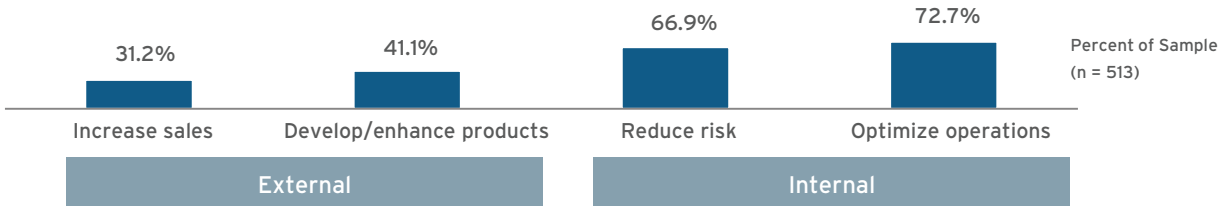


Figure 2: Enterprise IoT Drivers Are Primarily Inward-Facing

Source: 451 Research's Voice of the Enterprise: Internet of Things, Organizational Dynamics 2017



The goals of digital transformation and IoT projects vary by vertical market in our VotE: IoT quarterly surveys, with industrial verticals tilting more toward opex savings, while retail and enterprise focus more on potential benefits from worker safety, customer tracking and increasing the top line. We are also hearing from customers that projects often begin with a specific objective – usually cost savings from improved operational efficiencies – and then quickly pivot to leverage the newly installed technology for additional applications. One example of this is the installation of Wi-Fi and Bluetooth sensor technology for asset tracking in retail, which is subsequently used to monitor customer foot traffic throughout a store or warehouse in order to optimize layout and maximize sales.

Traditional IT technology vendors have made promising headway in partnering with systems integrators to deliver ready-made outcomes rather than pursuing the traditional model of selling discrete products or services for the customer to assemble into an outcome. Industrial vendors have known for many years that operational technology buyers purchase solutions and outcomes, such as condition-based maintenance or fleet management, and not sub-components to create their own solutions. This was a major obstacle to sales by IT vendors during the early years of IoT, but 2017 seems to be the year that all of the major players struck partnerships with global systems integrators that can deliver the full outcome from a combination of vendor components. It's fair to say that most of these same vendors are still struggling with finding the right combination of sales compensation components to steer their salespeople away from 'box sales' to these more margin-rich outcomes.

RECOMMENDATIONS

- **Enterprises: When embarking on a digital transformation journey, leverage the expertise of partners and vendors via 'co-creation' workshops.** Getting all of the internal stakeholders on the same page is a critical success factor, as is gaining a deep understanding (usually from vendors and systems integrators) of best practices within your industry and what technology options exist to achieve your desired outcome(s). We are seeing organizations struggle if they use the traditional IT model of buying technology components from multiple vendors and integrating them as proofs of concept (POC) in the lab, without consideration of the larger organizational objectives. Executive buy-in, and ideally leadership of the effort, is critical.
- **Vendors: Revisit how you monetize the value you deliver to the customer.** The model of selling a simple box or service is quickly giving way to selling the customer's desired outcome as a service. Whether this is a jet engine (GE), on-time rail transportation (Hitachi), or ready supply of blood (Haemonetics), vendors are leveraging the new sensor and use data available to fundamentally change how they deliver value to customers. Many of these customers are themselves pivoting to a consumption-based model of sales, which requires that their downstream suppliers also provide a usage-based model of outcomes as a bill-of-materials component.

WINNERS

- **Enterprises that pursue 'begin with the end in mind' digital transformation efforts, with executive sponsorship and broad organizational participation.** Adding expertise from systems integrators and vendors with background in the specific vertical industry can accelerate time to value by incorporating best practices within the industry and lessons learned from adjacent or otherwise similar environments. Identifying opportunities to provide value 'as a service' to customers, and ensuring that suppliers and vendors also provide their components as consumed, will additionally avoid potential conflicts between utility pricing and fixed cost structures.
- **Network operators that enable these digital transformations with a broad portfolio of high/low-bandwidth connectivity offerings as well as multi-access-edge enablement.** Network operators have a unique opportunity to develop value-added connectivity services tailored to each specific vertical market, reversing the 'race to the bottom' trend of connectivity pricing with services and connectivity options created specifically for each application. Low-power wide area networking technologies enable connectivity to billions of new IoT endpoints, all of which will need to be provisioned and managed. Multi-access edge computing (MEC) exploits the pervasive geographic footprint of network operators to deliver ultra-low-latency application performance for fixed and mobile IoT assets at a metro level, offering performance not possible from distant clouds.

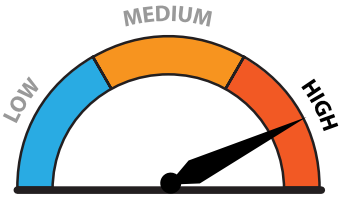
LOSERS

- **Vendors that stick to the quickly outmoded 'box sales' model of delivering value to customers.** As digital transformation shifts how end-user customers drive their businesses, and how they in turn deliver value to their own customers, vendors will need to adapt their own delivery models. End-user organizations offering value as a service will demand that their suppliers also provide a pay-as-you-consume pricing option where the customer is charged as value is realized. The legacy model of charging entirely up front (or up front with annual service contracts) will create a potential risk for enterprises that want to meter their pricing to their eventual customers.
- **Network operators that cling to cash-cow mobile connections and don't diversify into other licensed and unlicensed technologies, as well as value-added vertical market IoT services.** The majority of network operator revenues are generated from connectivity, but the industry has struggled against the commoditization of these connections based on price pressures. IoT will create demand for both high-speed/low-latency technologies such as 5G, edge and near-edge computing (MEC), low-power/low-bandwidth long-range wireless technologies, and a wealth of vertical-specific services in vertical markets such as transportation and energy/utilities. The operators that are willing to directly enter into these verticals with more than inexpensive connectivity will find a willing market and customers looking for partners that can help deliver the outcomes they are targeting.

TREND 2: COMPUTE, STORAGE AND REAL-TIME ANALYTICS WILL LIVE AT THE EDGE

Implication: *After a decade of the IT industry moving rapidly toward the centralized compute, storage and analytics architectures of the cloud, there has been an about-face in IoT, with a greater emphasis on edge compute and analytics. This will have drag-along impacts on how equipment ranging from on-site micro-modular datacenters to connected machinery is provisioned, orchestrated and secured, which will bring new complexity to enterprise analytics and networks.*

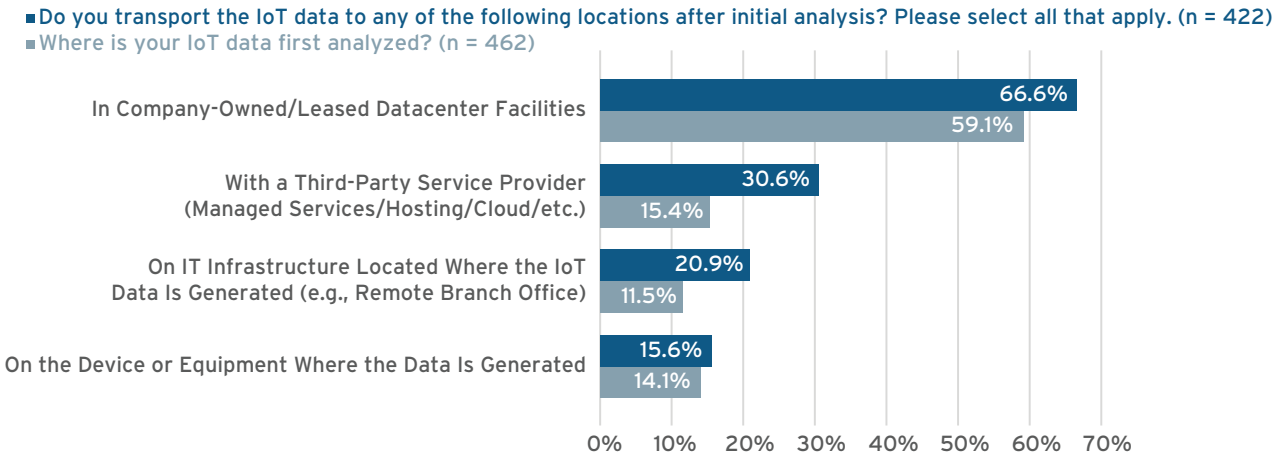
Impact to the Market



If 2017 will be remembered in the annals of IoT history for anything, it will be referred to as the year that the IT industry 'discovered' edge computing (see Figure 3). Edge computing, or local compute/analysis/action, has long been the default state for industrial control systems and on-board engine control units in vehicles, among many other applications. Where IT professionals may lean toward a 'cloud first' approach to solving technology problems, OT practitioners approach the space from a history of edge and embedded compute capability. IoT will ultimately evolve into a multi-polar topology with compute and analytics at the edge, in the cloud and in multiple areas in between, depending on the application and vertical market.

Figure 3: Most Enterprises Analyze IoT Data Locally

Source: 451 Research's Voice of the Enterprise: Internet of Things, Workloads and Key Projects, 2017



There are seven reasons for this multi-polarity of compute, storage and analytics:

- **The need for low/ultra-low latency for real-time applications.** These control-loop applications frequently demand response times in the sub-100ms or even sub-10ms range, which dictates that the compute assets are as local as possible **to offset the latency inherent in data transmission over distance.**
- **The cost of bandwidth.** IoT applications generate large volumes of relatively low-value time series data, in essence 'spamming' the cloud with frequent small updates. This data can be captured, analyzed (if necessary) and summarized before being sent to an upstream aggregation point, such as the cloud, far less expensively than sending unfiltered data over often-costly WAN links.
- **The availability of sufficient bandwidth.** IoT encompasses equipment such as freight trains and offshore oil rigs, which lack dedicated, high-speed connectivity, requiring that the analytics workloads happen locally, with a store-and-forward function to upload to an upstream analysis function when within range of a high-speed network connection.
- **Security.** Although cloud providers have developed excellent security for their IoT offerings, there is a healthy amount of mistrust on the part of OT professionals that their sensitive data will stay secure once it egresses the walls of their organization. These buyers are beginning their IoT trials with locally placed analysis, usually under the guise of flexibility and control (and low latency); however, conversations with these professionals typically turn over the security concern in short order.
- **Data sovereignty.** Security extends beyond just OT professionals, as nation states and other governmental bodies are reticent to share sensitive IoT data outside of sovereign boundaries, leading to this fifth reason for edge computing (and near-edge aggregation). The German Bundesdatenschutzgesetz (BDSG) data protection act is a frequently mentioned example of a national regulation that stipulates what and where data can be exposed, processed and stored.
- **Reliability in the case of WAN failure.** The remote site, such as a factory or semi truck, must be able to continue to operate independently absent a centralized analysis function.
- **Bridge to legacy systems.** The legacy systems being connected to the IoT frequently have non-IP/Ethernet interfaces, so will require a physical translation from analog or proprietary system interfaces for the data to be ingested and analyzed, which can only be performed adjacent to the original device generating the data.

The opportunity for these multi-polar analysis and computing capabilities is not insignificant. Custom research commissioned by the OpenFog Consortium and performed by 451 Research predicted that the fog computing opportunity will grow to be $18.2bn by 2022, with edge comprising $3.2bn of the larger number. This is outside of stand-alone edge-computing capability that is not distributed/federated analytics as defined within fog computing.

RECOMMENDATIONS

- **Cloud providers: Product management should identify which components of customer workloads fall into one of the seven cases outlined above, and strike partnerships (or develop products internally, or acquire companies with relevant capabilities) to host these edge applications.** Sticking to a cloud-only product and service portfolio will significantly limit the portion of the IoT application market that you will be able to address.
- **Enterprises: While many vendors may push for a cloud-first strategy for deploying IoT projects, it's critical to understand the requirements of each application's latency, security and data sovereignty constraints.** 2017 saw many large IoT technology vendors come to market with initial edge-computing solutions, so there is less need to compromise or pick an either/or strategy regarding where IoT analytics workloads are executed. Also, while the edge may be the best execution venue for initial analytics workloads, it may not be for secondary or tertiary data analysis, which eventually needs to happen at an upstream aggregation point where the analyzed data can be intermingled with other enterprise application data for interdisciplinary insights.

WINNERS

- **Edge computing platform vendors.** We differentiate between edge gateways, which are simply LAN/WAN bridges, and edge computing platforms that are capable of executing local analytical workloads (and possibly interfacing to legacy physical equipment interfaces). These vendors will find themselves the partnership (or acquisition) target of many major technology vendors that will need local execution partners for their IoT analytics tools.
- **Datacenter technology suppliers.** The trend toward centralization of compute, often at the detriment of buildouts of local datacenter facilities, will reverse with IoT where workloads demand one or more of the requirements surrounding latency, security, reliability and so on. This will, in turn, result in more sales of micro-modular datacenters and regional/local datacenters, as well as edge platforms.

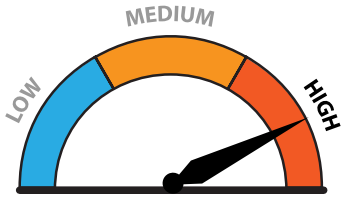
LOSERS

- **Cloud-only/off-premises solutions providers.** While the cost and complexity of providing a piece of the IoT puzzle from a centralized location is attractive to technology vendors, the reality of industrial customer environments is that the edge has played and will continue to play a dominant role. Innovations such as fog computing and the ability to conduct initial and secondary analytics/workloads close to edge devices will generate value for the foreseeable future.
- **Edge gateway vendors that don't evolve into platform providers.** 451 Research tracks dozens of IoT gateway vendors as part of our coverage, but the vast majority provide basic connectivity for a specific market or application, and rarely deliver application analytics on the device. This leaves a gap between initial connectivity and analytics that is likely to be addressed by stand-alone compute devices such as fog nodes, or in on-site (micro-modular) datacenters. The majority of revenue, and margin, will gravitate toward these latter vendors, and away from an increasingly commoditized gateway market.

TREND 6: INDUSTRIAL EQUIPMENT VENDORS/OEMS WILL 'BUILD IN' IOT

Implication: *The early phases of industrial IoT (IIoT) saw implementations adding capability to existing legacy equipment, with startups and industrial enterprise vendors providing additional computational and connectivity function as a bolt-on. This façade approach was, and still is, a necessity for equipment with a long life on the shop floor, but as equipment is replaced, or infrastructure upgraded, the new components can engage directly in IIoT systems across the enterprise.*

Impact to the Market

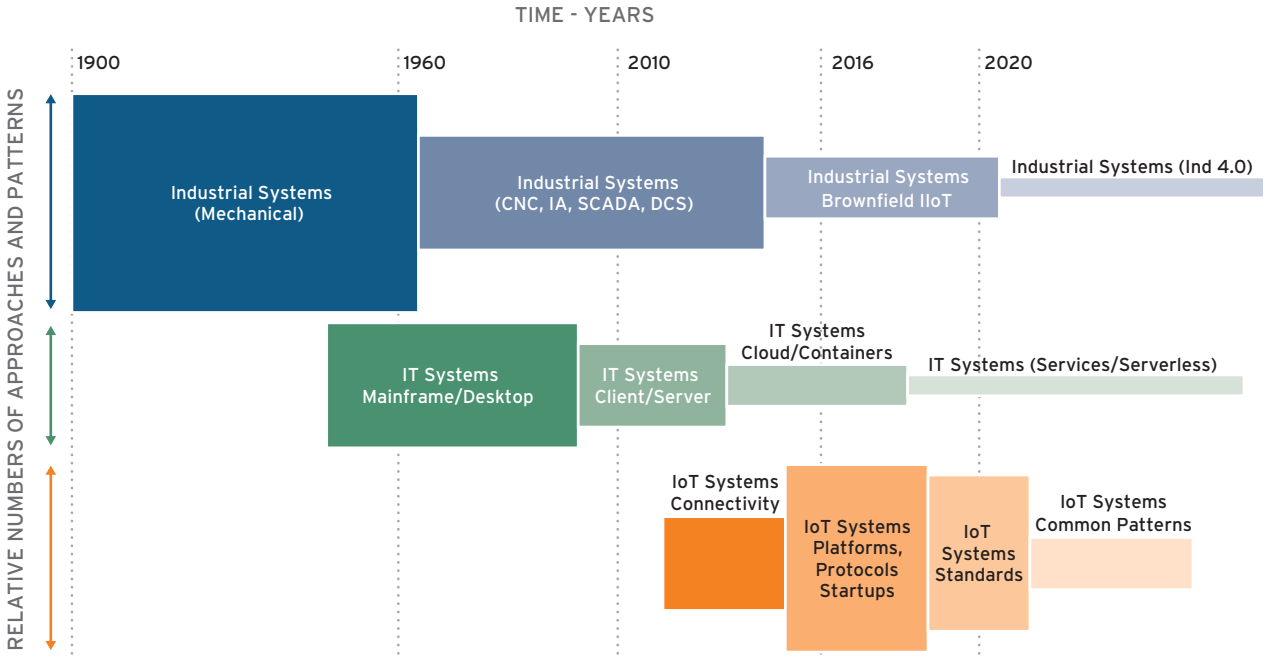


Industrial automation and its evolution to connect with the rest of the enterprise can be seen as OT edge computing 'discovering' cloud, just as Trend 2 above is the IT industry 'discovering' edge computing. The nature of industrial device communication has been highly focused on the internal needs of the process. To make that data available outside of those processes, wrappers have been required to reformat and deliver data to datacenters and cloud processing for enterprise-level analytics.

The convergence of industrial methodology, IT approaches and IoT moves toward a greater alignment of the three, with the digital components of industrial brownfield systems evolving from disconnected/proprietary approaches to ones that embrace the multi-vendor, interoperable model of IoT (see Figure 8). Bodies such as Germany's Industrie 4.0, The Industrial Internet Consortium (IIC) and Made in China 2025 bring together operational and information technology companies and standards to achieve this.

Figure 8: Evolution of Industrial Computing and IoT Types Over Time

Source: 451 Research, 2017



RECOMMENDATIONS

- **Enterprises (and the vendors that supply them): Remove as much hardware as possible from the stack.** Clearly processes in manufacturing need physical equipment, but elements such as supervisory control and data acquisition (SCADA) or distributed control systems (DCS) can be virtualized to run on standard industrial gateways, in local datacenters or in the cloud when common data standards are used. In addition, custom legacy networking adds complexity to maintenance and security and can be upgraded. This virtualization can improve standardization but does not preclude specialization and control to deal with physical differences.
- **Vendors: Engage in industrial IoT consortia test bed projects.** Industry POC exercises ensure interoperability between vendors. No one vendor will be able to deliver a unifying protocol or approach, so open standards are the way forward. This helps product development to engage in transferrable software assets to common virtual machines embedded at all levels of the processing hierarchy.

WINNERS

- **Equipment manufacturers that are already trusted providers in the OT space that have increased their IT capability and engaged in open standards.** Trust and ongoing relationships are a core element in industrial equipment supply. IT and software companies try to gain this reputational lock-in, but with manufacturing equipment installed and running for 30+ years and maintained by a skilled workforce, trusted suppliers are deep-rooted. Those suppliers that have engaged in enabling IIoT transformation, and now embed that function in their devices, will dominate IIoT.
- **Software vendors of IoT platforms that consume and support the emerging OT standards and approaches.** IT companies that look to evolve and work with OT standards rather than imposing a 'we know best' approach will do well. The multiple layers of industrial processes that have to deal with the twists and turns of the physical world offer different challenges than those of the more sanitized IT world. Industry-specific knowledge is essential here.

LOSERS

- **Equipment manufacturers that offer non-standard protocols or connectivity options to maintain vendor lock-in.** For a vendor, lock-in is obviously attractive and can be sold as an entire supported ecosystem, but this is not going to be successful in the long term. As more virtualization occurs, enterprises will look for choice. Rather than applications, a process will engage with a suite of services, as is occurring in the IT world today – individual case-by-case task performance becomes a metric. Inability to try other services stifles innovation and improvement, and hence harms the bottom line.
- **IT companies that do not partner directly with OT to understand the requirements of shop-floor integration.** The depth of experience in industrial automation and processes can be overlooked by some software platforms seeking to provide generic answers. The industrial world is a custom one, not one-size-fits-all.