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How IoT enables an Intelligent and Connected Supply Chain

The importance of an IAM-driven IoT platform

With its ability to drive performance and productivity across the entire supply chain, the Internet of Things (IoT) is fast becoming a major digital disruptor for those within the supply chain industry. In order for organizations to benefit fully from their IoT investments within a secure, intelligent and connected supply chain operation, businesses require an IoT platform built around Identity and Access Management (IAM).
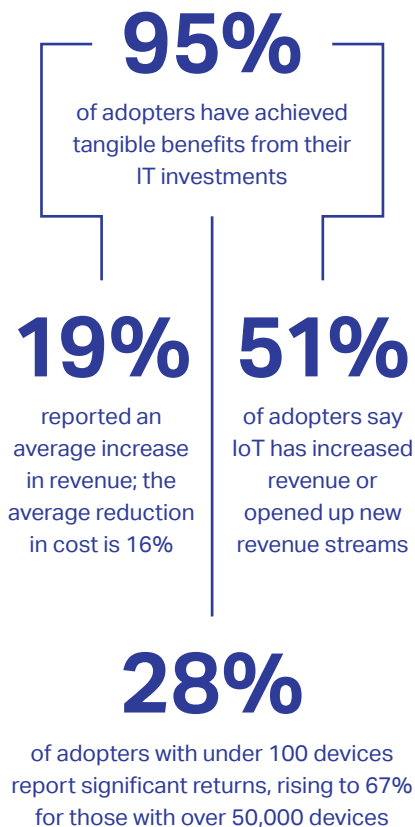
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The tangible benefits of IoT:[6]

IoT is spreading like wildfire. The number of companies adopting IoT doubled between 2013 and 2017

And it's no wonder:

95%

of adopters have achieved tangible benefits from their IT investments

19%

reported an average increase in revenue; the average reduction in cost is 16%

51%

of adopters say IoT has increased revenue or opened up new revenue streams

28%

of adopters with under 100 devices report significant returns, rising to 67% for those with over 50,000 devices

Join the IoT revolution.

74% of companies agree that digital transformation would be impossible without IoT.

Reshaping the supply chain with IoT

Amid an environment of increasingly global and complex supply chains, organizations must collaborate closely with customers, suppliers and partners to achieve realtime visibility across every part of the supply chain. The Internet of Things offers the potential to develop new capabilities to revolutionize supply chains.

The Internet of Things (IoT) has arguably been one of the biggest technology success stories of all time. The speed at which IoT-enabled devices have become a part of our daily lives has been astounding. By 2025, some predict we'll see 75.4 billion connected IoT devices—up from 15.4 billion a decade earlier.[1] That's equal to ten IoT devices for everyone on the planet.[2]

McKinsey & Company estimates that IoT could generate as much as $11 trillion a year by 2025, which would represent fully 11 percent of the world's economy.[3] While most of this value will be generated within business, factories and logistics will feature prominently. Amid these environments, connecting physical and digital infrastructure boasts clear advantages that are reflected in the Boston Consulting Group's prediction that by 2020, 50 percent of all IoT spending will come from the manufacturing, transportation and logistics and utilities industries.[4]

According to McKinsey, business to business (B2B) applications will account for over 70 percent of all value generated by IoT, although the firm's research found that the hype surrounding IoT tended to undermine its full potential.[5] In order to realize the full potential of IoT, companies needed to identify areas in which IoT could generate real value and create an IoT-capable infrastructure.

This paper highlights the importance of investing in an enterprise-wide IoT platform focused on identity and access management (IAM). It also explores how IoT can be leveraged across three key supply chain activities:

• Visibility of shipments as they move across global supply chains

• Automated replenishment of procurement processes

• Predictive maintenance of IT and supply chain equipment

1 Statista, "Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025."

2 Ibid.

3 https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

4 Forbes, "Internet Of Things Market To Reach $267B By 2020," 2017.

5 https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

6 Vodafone, IoT Barometer 2017/18.

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Growing the supply chain with IoT

Recent research from IDC showed that 63 percent of companies have already begun to implement IoT within their supply chain.[7] Today, most implementations occur within one or very few functional areas. Only 15 percent of companies said they had fully implemented IoT across their entire supply chain. Three years later, that figure had risen to nearly a quarter of all respondents, which demonstrates the rapid advance of IoT as companies begin to realize its benefits.

According to IDC research, most companies are already benefiting from the use of IoT—benefits that include increased service performance, improved product quality, increased supply chain visibility, improved productivity and reduced costs (*see figure 1*).

Please indicate whether or not you actually accomplished or realized tangible benefits for each goal related to digital transformation efforts for Internet of Things within your organizations' supply chain.
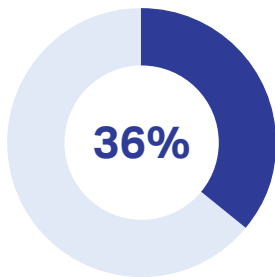
36%

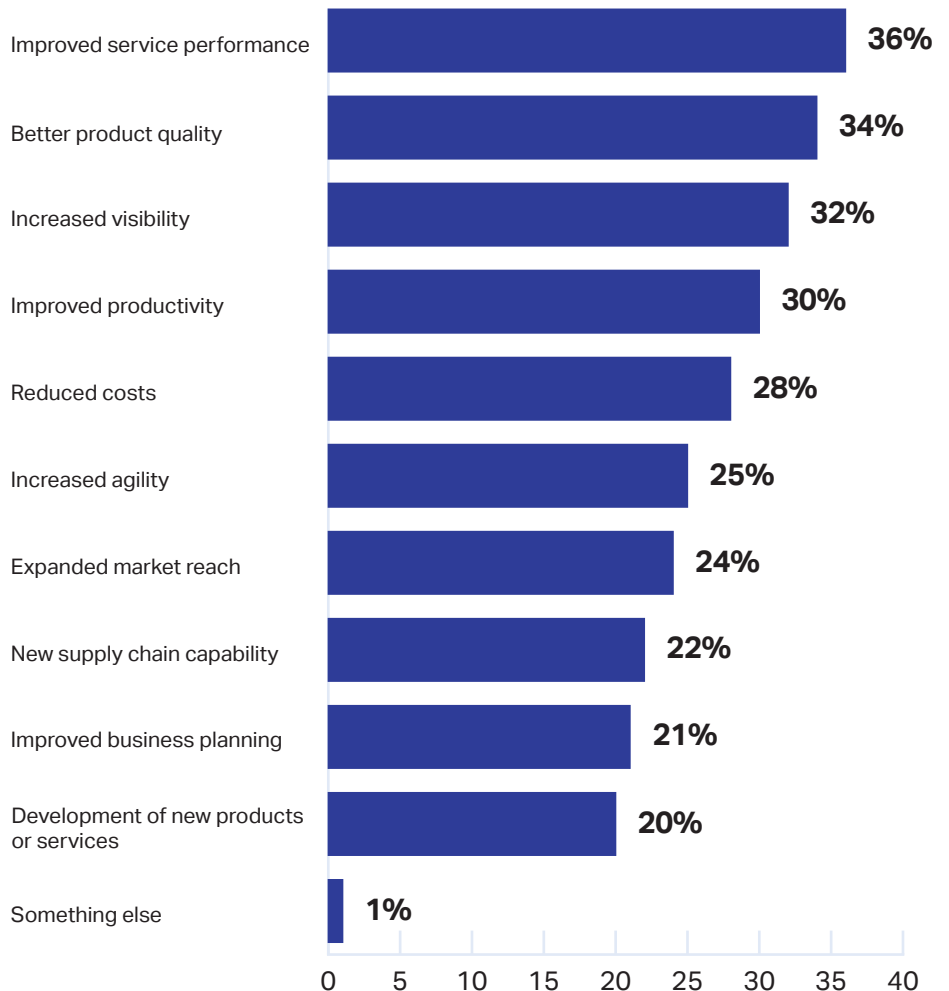**of respondents said they used the Internet of Things to improve service performance.**

Improved service performance	**36%**
Better product quality	**34%**
Increased visibility	**32%**
Improved productivity	**30%**
Reduced costs	**28%**
Increased agility	**25%**
Expanded market reach	**24%**
New supply chain capability	**22%**
Improved business planning	**21%**
Development of new products or services	**20%**
Something else	**1%**

0   5   10   15   20   25   30   35   40

Figure 1: Benefits of IoT in relation to broader digital transformation initiatives.

7 IDC, Digital Transformation Drives Supply Chain Restructuring Initiative, 2017.

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Regarding specific supply chain specific business processes, the same study from IDC found that IoT could benefit supply chain operations in many different ways, which are shown below in Figure 2.

With regard to the IoT, and the use of sensors, what type of supply chain processes (or use cases) would provide the most benefit for your organization?

67%
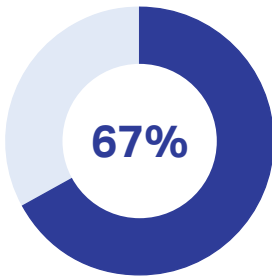
of respondents said in relation to IoT, improved inventory management would be the main benefit.

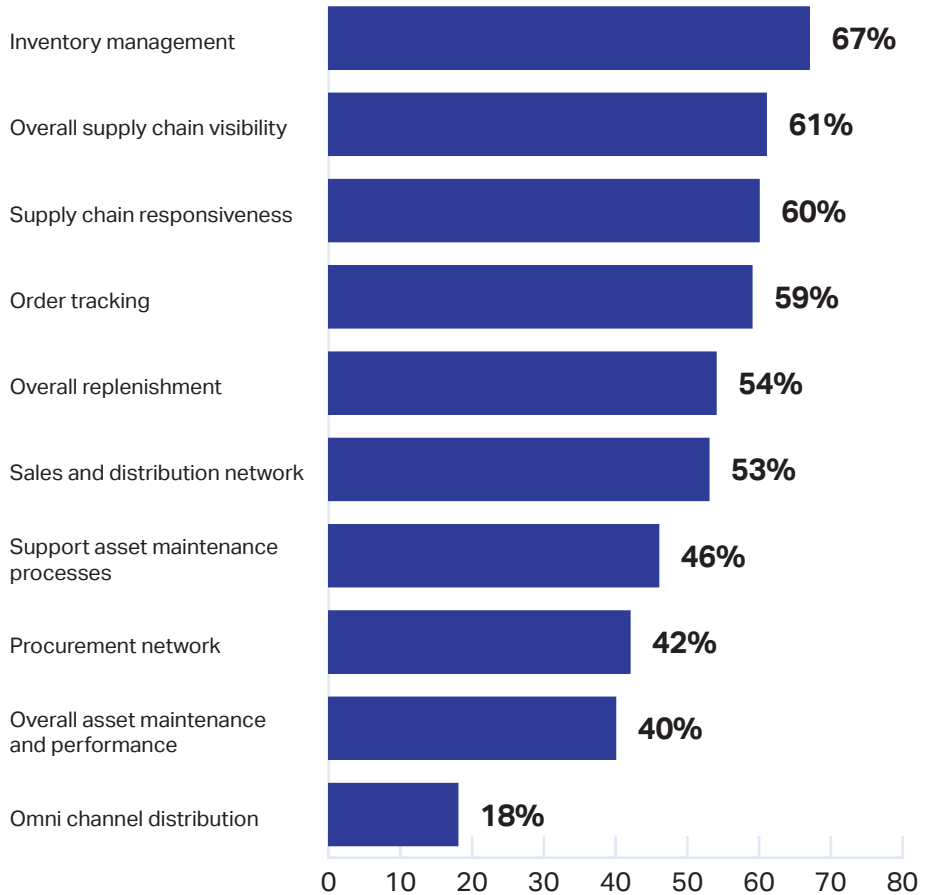|	
Inventory management	67%
Overall supply chain visibility	61%
Supply chain responsiveness	60%
Order tracking	59%
Overall replenishment	54%
Sales and distribution network	53%
Support asset maintenance processes	46%
Procurement network	42%
Overall asset maintenance and performance	40%
Omni channel distribution	18%

0   10   20   30   40   50   60   70   80

Figure 2: Supply chain processes that benefit the most from IoT.
Source: OpenText Digital Transformation in the Supply Chain Survey, IDC, December, 2016

Given its ability to deliver, it's easy to understand why IoT has become the top investment priority within the supply chain of many organizations.[8] In a 2016 AT&T and EFT survey, nearly 70 percent of executives expected to see payback from their IoT investments within 24 months.[9] Today, almost 50 percent of transport and logistics companies say they're using IoT as part of major business transformation initiatives.[10]

And yet, challenges abound. Most companies that have implemented IoT in their supply chain are currently using connected devices for notifications and realtime monitoring rather than for optimizing and transforming their supply chain operations.[11]

8 eft and AT&T, The Internet of Things (IoT) in Supply Chain and Logistics, 2016.
9 Ibid.
10 Vodafone, IoT Barometer 2017/18.
11 eft and AT&T, The Internet of Things (IoT) in Supply Chain and Logistics, 2016

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Evolving the supply chain with IoT

Many of the devices that underpin IoT have been deployed across the supply chain for several years. However, these devices were most often run on proprietary networks, and could therefore capture only that data relating to its specific function. In the first iteration of IoT development, existing passive sensors are being replaced with IoT devices that can provide realtime monitoring and reporting on every aspect of the supply chain, such as the location, temperature, humidity and time of arrival, as well as changing equipment settings and process workflows to optimize performance.

Currently, most companies are using their IoT devices for the monitoring and alarm functionality of their previous sensor and tagging technologies. However, most supply chain executives are cognizant that the real power of IoT lies in intelligently connecting people, processes, data and things—and exploiting that intelligence to radically change business processes.

Ultimately, the goal is to enable realtime and informed decision-making that allows organizations to move beyond efficiency and cost improvements toward implementing more effective business strategies around new product development, proactive inventory management and demand-driven production.

While IoT can be narrowly defined as the interconnection of devices embedded in physical objects that can send and receive data via the internet, this doesn't explain how IoT can help optimize the supply chain. In a broader sense, IoT can be defined as follows:

> "The collection, consolidation and processing of data coming from a network of physical objects and the conversion of that data into actionable intelligence."

Within the supply chain, IoT is a three-stage process:

- **Data collection:** Collecting data not only from IoT devices, but also from people, processes, and other systems and infrastructure

- **Data consolidation:** Converging all data into extremely large data pools—often called *data lakes*—and ensuring access to structured and unstructured data held in disparate repositories internally and externally

- **Data conversion:** Leveraging cloud platforms with advanced analytics capabilities to gain full intelligence and value from the data

Most IoT adopters agree that IoT involves much more than simply connected devices. Certainly, IoT also involves capturing data from connected devices and then analyzing and acting on that data. In a 2018 Vodafone survey, over 82 percent of respondents agreed that IoT isn't a standalone technology. In fact, it's intrinsically linked to analytics, artificial intelligence (AI) and other critical digital initiatives.[12] Supply chain researchers EFT found that machine learning is now a top investment priority, whereas it did not feature at all as recently as 2014.[13]

12 Vodafone, IoT Barometer 2017/18.

13 eft and AT&T, The Internet of Things (IoT) in Supply Chain and Logistics, 2016

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However, the EFT research also highlighted some of the challenges that organizations face as they evolve their IoT capabilities from that of simple reporting and alerting into those that will optimize their supply chain. As more companies add more devices, the amount of data they are required to handle grows exponentially. Indeed, most supply chain organizations are struggling to cope. In one EFT survey, 61 percent of respondents stated that they analyzed less than half of their IoT data.[14]

Further, modern supply chains require close collaboration with customers and suppliers. The EFT research highlighted the strides that many organizations have made in connecting and accessing information from third-party devices, assets and people. Over 40 percent of respondents were gathering data from third-party mobile assets, such as trucks, boats and planes, as well as integrating directly into IoT supplier networks.[15]

In order to share data and turn that data into intelligence, an IoT-enabled infrastructure must focus on secure and trusted connections for people, processes, systems and things. Such a structure must enable all forms of connection, from machine-to-machine, machine-to-person and machine-to-application, without placing undue administrative or processing burden on the organization.

Creating the digital ecosystem

In order for IoT to be effective, all elements of the supply chain must be connected—a connection that requires a seamless and secure interaction of people, systems and things. The digital supply chain is fast becoming the "Intelligent and Connected supply chain," thus representing the next stage in digital transformation. The digital ecosystem offers a holistic approach to bringing big data, IoT, analytics and AI together to achieve dramatic business transformation.

Connected people	Connected systems	Connected things
The identity personas and lifecycle of everyone that interacts with your digital assets and connected products—employees, suppliers and customers.	The secure sharing of information between disparate systems in the right format at the right time and on the right device.	Advanced IoT services for the many consumer and industrial devices that need to connect and exchange information.

14 eft and AT&T, The Internet of Things (IoT) in Supply Chain and Logistics, 2016

15 Ibid.

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In effect, the organization is creating a "digital ecosystem," of which IoT devices are but one component (*see figure 3*). The ecosystem is built around a single digital backbone that connects and integrates with any person, device or enterprise system across a highly complex environment, such as a global supply chain, thus providing the foundation on which to link internal enterprise systems and external trading partner communities.
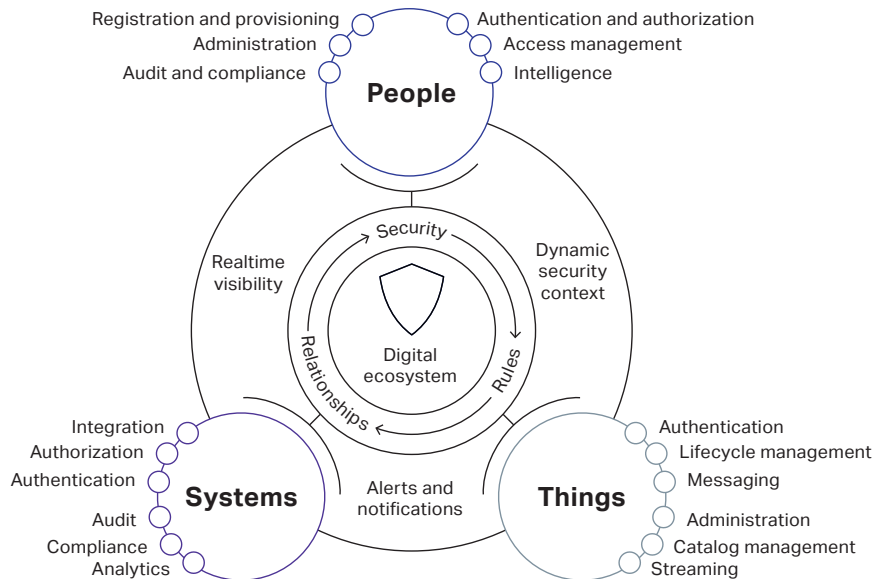

Figure 3: The Digital Ecosystem

The enterprise-wide IoT platform forms the basis for deploying and managing a digital ecosystem—a central platform that will allow organizations to quickly build and deploy new IoT applications, collaborate with suppliers and customers and optimize supply chain performance while mitigating compliance risks. According to IDC, by the end of 2020, 50 percent of new IoT applications will leverage an IoT platform that offers outcome-focused functionality based on comprehensive analytic capabilities.[16] The challenge for all organizations seeking to fully exploit an IoT platform lies in how to drive security across the entire digital ecosystem while also ensuring safe and appropriate access.

Recognizing the vital role of Identity and Access Management

Although IoT security is improving, challenges remain. Research from Vodafone shows that 75 percent of companies list security as their chief consideration when selecting connectivity for IoT projects.[17]

Among IoT users, security is certainly their primary concern. Organizations therefore need an exacting means of protecting devices, data, systems and enterprises from cyberattacks and privacy breaches.

Identity and Access Management (IAM) is one of the key elements of an IoT platform. IAM provides secure information sharing and trusted interactions among all entities in the IoT network. Gartner's research states that by 2020, there will be 215 trillion stable connections—63 million new ones every second.[18] As IoT connections grow, trusted interactions become increasingly essential. Each connection must therefore be carefully managed, and the IoT platform must enable data flow into processes across the supply chain.

16 EnterpriseAppsTech, "A roundup of 2018 enterprise Internet of Things forecasts and market estimates."

17 Vodafone, IoT Barometer 2017/18.

18 Mobile, ID World, "Mobile Identity, Biometrics, Cloud and Micro-services Hot Topics at 2017 Gartner IAM Summit," 2017.

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The sheer scope of this challenge is demonstrated by estimates that suggest that as many as 70 percent of all IoT devices have security vulnerabilities[19] and that in 2017, 81 percent of all cyberattacks were credentials-based.[20] Guarding the perimeter is no longer enough: security revolves around how various entities gain access to the network. Integrating IAM into the IoT platform then, enables an organization to:

- Provide secure and seamless data exchange across organizations and systems

- Manage the online and offline state of entities and sync data across networks and in the cloud

- Manage the lifecycle of entities as roles and authorizations evolve

- Control entities' use of protected resources

- Administer access and manage entities' access

- Integrate disruptive disparate technologies (cloud and on-premises applications) as well as legacy systems and data repositories

- Manage global compliance and governance

- Seamlessly connect to internal enterprise systems and external trading partner communities

Security is at once a major concern and a key enabler. Within the supply chain, IoT is not a task that a single organization can achieve in isolation. Rather, IoT must function alongside suppliers, logistics providers and other partners. The level of collaboration needed to optimize supply chain performance requires trusted access into the systems of trading partners. Vodafone's research revealed that 79 percent of companies view IT security as a key enabler of building trust when moving online[21]—security that is best achieved through an IAM-driven IoT platform.

Deploying the IAM-driven IoT platform

Adopting an "identity-centric" approach to IoT allows organizations to develop an IoT platform that enables users to rapidly deploy and deliver many components in order to drive supply chain performance. This approach allows organizations to manage the lifecycle of devices, systems and people from initial provisioning to final deletion. Notably, the platform delivers powerful capabilities to manage the relationships between entities, and its ability to audit and track every event associated with every entity delivers complete transparency across your digital ecosystem.

The IAM-driven IoT platform enables vast amounts of structured and unstructured data from various sources to be rapidly ingested and aggregated in large data sets. A unified data model allows all data to be normalized across the entire ecosystem. The platform can then apply a series of services to the data to meet the needs of the business processes within your supply chain (*see figure 4*). Its integrated advanced messaging and orchestration services enable the flow of data among devices, systems and people, thus removing the need for separate machine-to-machine, machine-to-application and machine-to-people integrations.

19 Security Week, https://www.securityweek.com/70-iot-devices-vulnerable-cyberattacks-hp
20 CSO from IDG, "Identity Trends 2018: The More Things Change, the More Things…Change," 2018.
21 Vodafone, IoT Barometer 2017/18.

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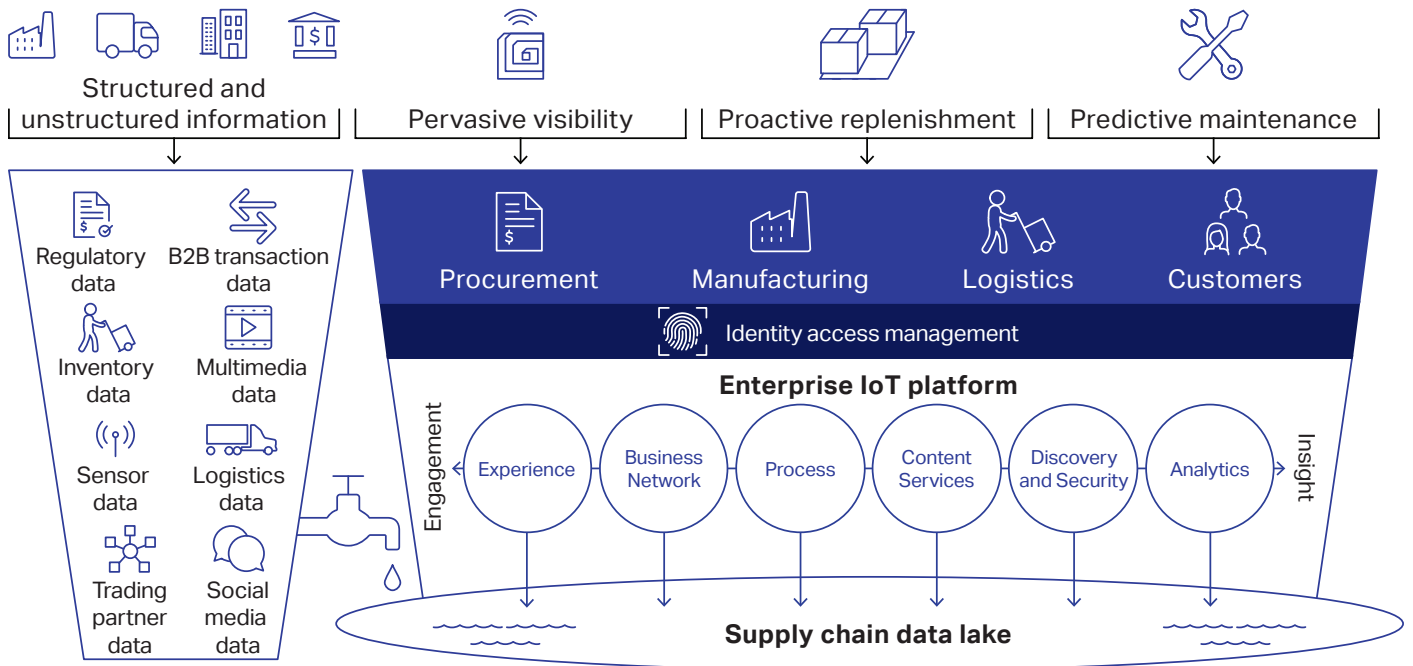Figure 4: The IAM-driven IoT platform

Core services for the IoT platform include:

Analytics	Embed analytics including AI and machine learning to mine sensor data and identify trends to trigger event-based supply chain processes.
Content Services	Deliver a centralized hub to manage and archive all types of digital information coming from connected IoT devices.
Discovery and Security	Explore and identify key information coming from trading partners to discover early insights into supply chain and connected device behavior.
Process Management	Ensure that sensor-based information aligns and supports key supply chain processes and helps automate key supply chain workflows.
Experience Management	Provision web portals and mobile apps to configure connected devices and archive multi-media related information.
Business Network	Enable the seamless, secure flow of information across an extended business ecosystem of partners, systems and devices; simplify inherent complexities and gain insights to drive efficiencies and speed time to revenue.

The IoT platform should enable the rapid development of IoT applications to drive innovation and agility within the supply chain. A template-driven approach allows new IoT projects to be created and deployed quickly across the entire enterprise.

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IoT in the supply chain: Three essential use cases

The effective deployment of IoT increases the speed and accuracy of decision-making through advanced analysis of all data available to the enterprise. IoT can deliver faster cycle time, improved customer experience, new products and revenue streams and flexible and agile business processes. Figure 5 highlights three use cases that offer the potential for great value to supply chain operations.

Pervasive visibility	Proactive replenishment	Predictive maintenance
RFID/GPS		
IoT provides improved end-to-end visibility of shipments through highly connected supply chain "assets" across multi-modal 3PL providers.	IoT provides realtime monitoring of inventory levels and consumption patterns, which will automate replenishment processes with suppliers.	IoT maximizes asset availability by monitoring potential part failures and automatically initiating a replacement part procurement process.

Figure 5: Supply chain use cases for IoT

Pervasive Visibility

Knowing an item's location, condition and delivery time is of vital importance to all supply chain operations. While the previous generation of tags and sensors could provide some information on location and condition, its scope proved limited. As the elements weren't connected, it wasn't possible to track items in realtime. More important, the data they created was isolated from other relevant data. For example, a barcode could provide information about the location of a pallet when it arrived at a warehouse, but this information couldn't be correlated with the temperature of the item during transit.

IoT provides improved end-to-end visibility of goods "from floor to store," thus enabling the continuous and pervasive flow of data from highly connected supply chain assets during every stage of the process. This visibility includes tracking and monitoring of multi-modal 3PL providers, optimization of warehouse operations and improvements in "last mile" delivery.

The key to Pervasive Visibility lies in a new generation of cloud-based Geographical Positioning Systems (GPS) and Radio Frequency Identification (RFID) tags and sensors. These tags and sensors provide granular, realtime information of item identity, location and other tracking information. They also provide environmental information such as temperature, humidity and even the condition of the pallet.

With Pervasive Visibility, the supply chain professional has a complete picture of every item as it passes though the supply chain, allowing the organization to achieve unprecedented levels of control and transparency to ensure that the right product is delivered at the right time in the right condition and at the right cost. Figure 6 highlights a pervasive visibility use case relating to the monitoring of perishable goods moving through a supply chain.
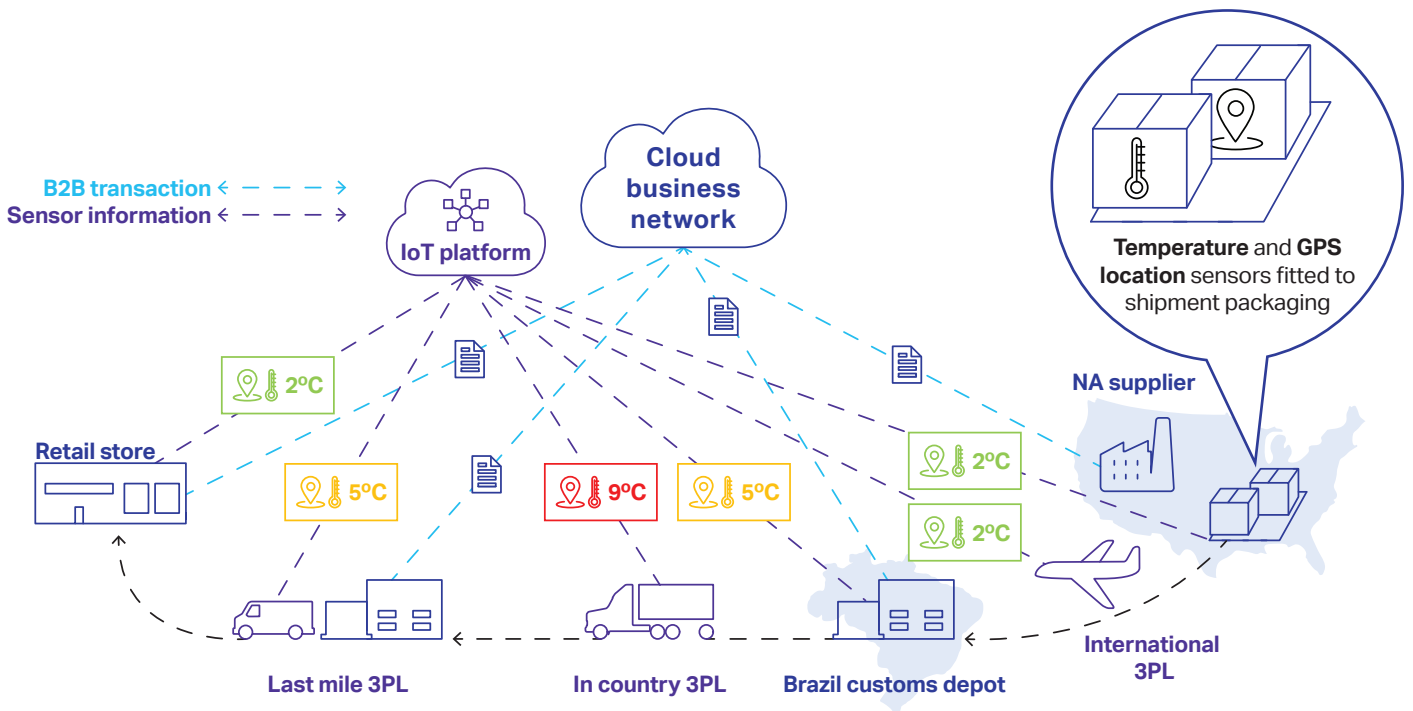
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Figure 6: Using IoT to track perishable goods through the supply chain

Pervasive Visibility delivers:

Improved asset utilization

Through continuous monitoring, it is possible to measure the performance of any asset in the supply chain and effect change when required. Pervasive visibility delivers complete control, which means knowing what assets are currently doing and what they will do next. This data facilitates analysis that identifies when assets are underperforming and how to better utilize assets to improve business performance. In this way, an organization can begin to increase the automation within business processes to eliminate manual intervention, improve quality and reduce costs.

Improved fleet management

The connected vehicle is one of the breakthrough use cases for IoT. Today, millions of car owners are benefiting from a series of in-car services, including predictive maintenance and emergency support, delivered from a central IoT platform. The connected vehicle has even greater application within the commercial world as the basis for improved fleet management. For example, a container in transit can be tracked by the meter or by the second. Not only can trucks continually report on the performance of the vehicle and the condition of the cargo, but they can also communicate with the driver to advise on optimal speeds and routes.

Optimized warehouse management

Combining IoT with other supply chain systems creates a "smart warehouse" that can boost responsiveness and efficiency. Using sensors, tags on pallets, video cameras and wearable devices, such as smart watches and glasses, staff can chart each item's optimal time and path prior to its arrival. In addition, IoT can improve the performance and safety of autonomous vehicles—such as forklifts—as they travel around the warehouse.

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Reduced supply chain risk

With so many geographically dispersed organizations in the global supply chain, there is ample room for uncertainty, which breeds supply chain risk. Any number of factors can affect or delay order fulfilment. Although reduced supply chain risk has previously been difficult to predict and control, IoT can improve control over goods in transit. At a tactical level, IoT can provide constant information on road and weather conditions to the driver and head office to plot the optimum delivery route. This feature enables constant delivery status in realtime to the customer, thereby creating an enriched customer experience. Strategically, IoT—when applied to AI and analytics—is becoming extremely good at predicting and planning for adverse events (such as natural disasters) with the aim of reducing risk and increasing business continuity.

Proactive Replenishment

Inventory optimization is key for every company, with estimates suggesting that up to 7 percent of U.S. GDP is tied up in inventory.[22] Reducing inventory levels while improving customer experience requires the ability to automate much of the replenishment process in order to continuously monitor stock levels and restock as required.

Improved inventory management

To avoid an "out of stock" situation that may lead to lost sales, tags and sensors can be added to all items. These sensors are then connected to the Warehouse Management System to provide realtime inventory visibility. In addition to stock levels, the IoT platform can indicate the condition of each item, such as the storage temperature or expiration date, to ensure the quality of the items in the supply chain.

To ensure that the right items are shipped in the right order, during outbound delivery, pallets are scanned when leaving the warehouse. The system then automatically updates stock levels and triggers the replenishment process if required.

Introducing demand-driven replenishment

The growing use of IoT in the retail and store environments allows an organization to capture in-depth information on customer preferences. Along with consumption monitoring analytics, shelf sensors provide immediate notification when retailers are running low on stock and can automatically trigger replenishment (*see figure 7*). In addition, IoT data allows companies to predict future buying patterns quickly and accurately. Organizations can begin to build their inventory based on actual customer demand, consequently reducing the amount of stock held in the supply chain to ensure the correct levels of availability.

22 Veridian, "Supply Chain Inventory Optimization – Beyond the Analytics"

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1. Material consumption trends	2. Distributor replenishment process

- ■ Proximity based sensors
- ■ Connected devices
- ■ Enterprise IoT platform
- ■ GPS / RFID network
- ■ Wi-Fi network

Cloud analytics platform ←Integration→ Cloud business network

From vendor managed inventory to 'device managed inventory'

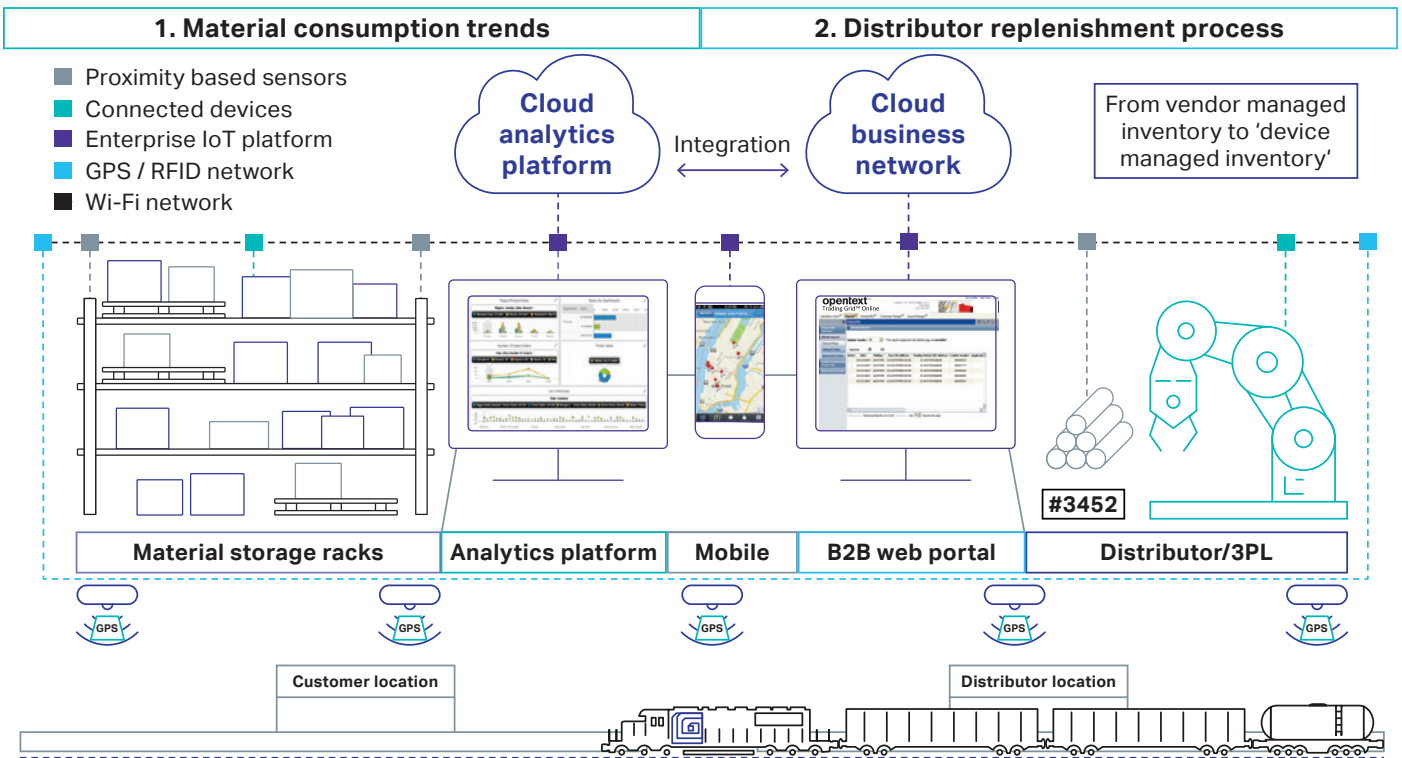| Material storage racks	Analytics platform	Mobile	B2B web portal	Distributor/3PL

#3452

Customer location

Distributor location

Figure 7: Proactive, automated replenishment using an IoT platform

Predictive Maintenance

Being able to predict when part of sub-system of a serviceable product is likely to fail continues to be a key investment area for the supply chain. Whether a given a part is within the production process, the warehousing environment or part of a connected fleet vehicle, IoT enables proactive monitoring and analysis that can boost the performance and lifespan of the part as well as ensuring the availability of the entire sub-system.

Predictive maintenance has become a key use case of IoT. By attaching sensors to the physical asset, they can immediately alert the supply chain professional when it is operating outside acceptable levels. When applied to advanced analytics and machine learning, the IoT platform can determine whether the part needs to be replaced or repaired and then automatically trigger the correct process.

We draw this conclusion not only from the history and past performance of a particular asset, but also from a range of data sources covering similar asset types, sub-systems and operating conditions—information that can provide intelligence and enable a more informed decision.

For example, the flow rate sensor attached to a hydraulic pump on a train's braking system may alert the IoT platform to pressure loss in the hydraulic pump. The machine learning and AI capabilities within the IoT platform can then decide whether to repair or replace the part. The IoT platform then automatically triggers the correct process (either to repair or replace a failing part) and initiates any supporting processes, such as parts ordering, work orders and documentation exchange needed to ensure that maintenance is completed as quickly and efficiently as possible (*see figure 8*).

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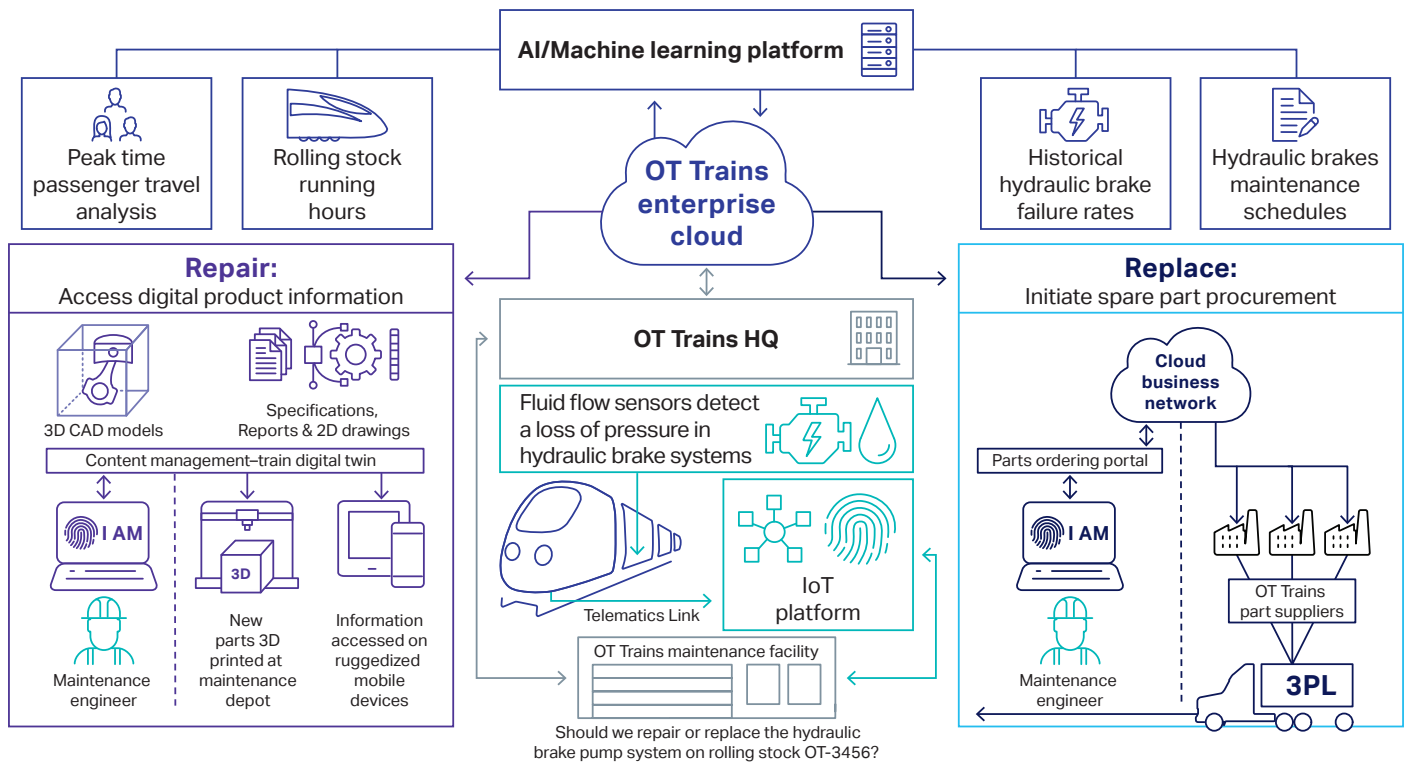Figure 8: Predictive maintenance using an IoT platform

Conclusion

Today, organizations are reaping competitive advantage by managing their supply chains as a strategic asset. Increasingly, companies are working with suppliers worldwide to increase supply chain efficiency and collaborate on ways to drive customer experience and create new products. Indeed, with operational efficiencies and revenue opportunities, the IoT is set to revolutionize the supply chain—offering the potential to radically improve the performance of its supply chain. However, like the supply chain itself, IoT-based solutions involve a complex ecosystem of devices, systems and people. Reaping the full benefit of any IoT investment, then, requires an enterprise IoT platform that can quickly and easily create new IoT applications that address the key use cases—such as Pervasive Visibility, Proactive Replenishment and Predictive Maintenance—for IoT in the supply chain.

Advanced Identity and Access Management, by necessity and design, must form one of the platform's core components. Only by implementing an IAM-driven IoT platform can organizations begin to enable the secure and trusted interactions needed to achieve close collaboration with trading partners and optimization across the entire supply chain operations.

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About the OpenText Covisint IoT Platform

The IoT platform from OpenText Covisint is the first to take an identity driven approach to securely managing access, lifecycle and relationships across a complex digital ecosystem of people, systems and things. It consists of four key components:

Relationship and lifecycle management

Enables organizations to manage relationships among people, systems and things—across the entire lifecycle of each.

Ecosystem management

Secures, enables and manages trusted interactions across the digital ecosystem, including machine-to-machine, machine-to-application and machine-to-person.

IoT messaging

Integrates legacy and modern messaging technologies to enable the rapid delivery of agile and flexible IoT applications.

Unified data model

Normalizes all data from people, systems and things—regardless of the underlying technology.

The OpenText Covisint IoT Platform enables asset intensive business—such as supply chain operations—to manage and implement smart, connected processes and pursue operational excellence.

For more information, visit opentext.com/connected-supply-chain

About OpenText

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