



THE SENSOR REVOLUTION

**HOW ENTERPRISE SENSOR INTEGRATION (ESI)
IS ENABLING THE INTERNET OF THINGS**

OVERVIEW

There's a lot of buzz surrounding the Internet of Things (IoT) – a world in which everything is smart and connected. It's all about making data come together in new ways, and it has the potential to change all aspects of our lives.

The IoT is fueling a programmable economy in which our homes, cities, factories and power plants will be interconnected and managed through the internet. In this data-driven world, smart devices will communicate with each other and coordinate actions on a common platform. The payoff is huge, experts say, including increased efficiency, lower energy consumption, less traffic congestion, and better healthcare.



For manufacturing and supply chains, the IoT has set in motion a fourth Industrial Revolution, also known as the Industrial IoT, or Industry 4.0. Powered by the internet, the IoT will make factories smarter, more efficient and productive. The IoT promises to significantly improve visibility on the factory floor, reduce down time and improve the bottom line for industries such as healthcare, automotive, oil and gas and aerospace.



The IoT also promises to provide significant benefits to the defense industry. By leveraging this interconnected architecture, military forces can increase efficiencies, reduce costs and enhance situational awareness across the full spectrum of defense logistics management.

The IoT is about creating an efficient environment where data is captured and turned into actionable insights. It involves the collection and analysis of “Big Data” – massive volumes of data pulled from multiple sensor sources that

deliver powerful analytics. Big Data is generated from “smart” sensors embedded in physical objects that communicate through networks. The data is consolidated and managed through sensor fusion. This intelligent connection of large volumes of data will facilitate data-driven, highly efficient manufacturing and supply chain processes.

INDUSTRY CHALLENGES

The Internet of Things is estimated to be a \$19 trillion market over the next few years, and technology suppliers are all vying to get their piece of the IoT market. As a result, there's been a proliferation of stove-piped IoT technologies that have posed significant interoperability challenges for industries.

Organizations are faced with a plethora of asset tracking solutions that do not speak the same language. There is a lack of integration among technologies such as Radio-Frequency Identification (RFID), barcodes, transponders and Enterprise Resource Planning (ERP) systems. Many IoT solutions are proprietary technologies that are not interoperable with other brands, data formats or legacy systems. The end result is inefficient operations with increased costs due to:

- Loss of asset visibility and accountability
- Unreliable inventory data
- Suboptimal supply chains
- Suboptimal operations

THE GATEWAY TO THE INDUSTRIAL IoT

ESI: A SENSOR AGNOSTIC PLATFORM

Tapestry Solutions, Inc. has addressed the IoT challenges with its Enterprise Sensor Integration (ESI) technology. ESI is an innovative integration platform that connects disparate sensor technologies through a standard interface, seamlessly connecting people, data and processes.

- With ESI, there's just one platform that can communicate with many different hardware and software vendors' IoT solutions
- ESI interfaces with major RFID vendors as well as sensor-based solutions from Oracle, SAP and other industry leaders.

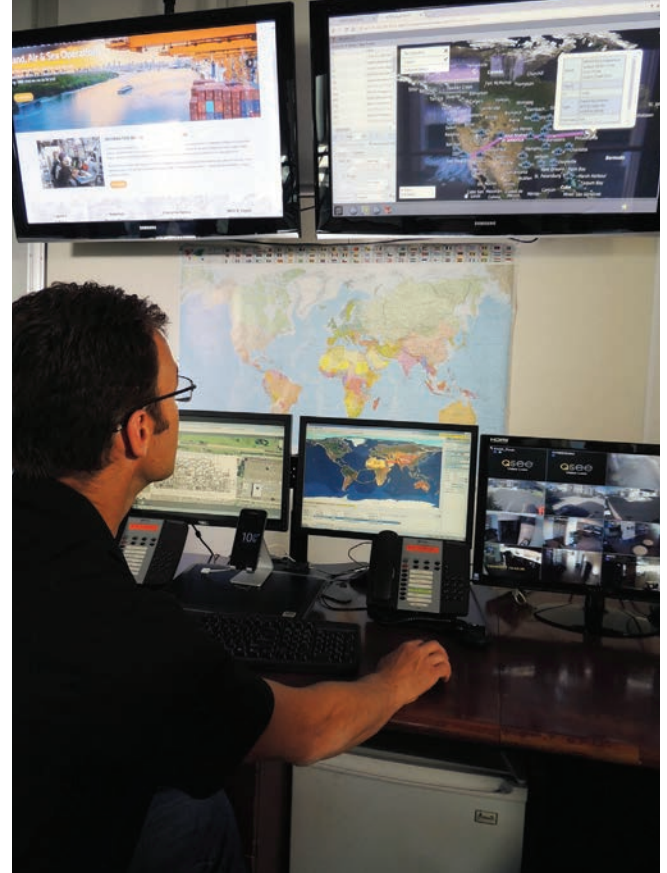
GLOBAL ENTERPRISE SCALABILITY

Unlike other IoT sensor solutions, ESI is a cloud-based platform that can be implemented across a global enterprise. With ESI, supply chain visibility is not completely dependent on one manufacturer or sensor type. This ensures total asset visibility of equipment, tools, cargo and processes anywhere in the world.

A FLEXIBLE PLATFORM

ESI is a flexible platform that supports a broad range of missions and operations including:

- Global Supply Chains
- Industrial Manufacturing
- Depot Maintenance Operations
- Defense Logistics Operations
- Commercial Asset Tracking



Unlike other IoT sensor solutions, ESI is a cloud-based, sensor agnostic platform that has global enterprise scalability



A PROVEN APPLICATION

ESI leverages technologies that Tapestry developed for Boeing – the world's largest aerospace company. At Boeing, the technology is called the Automated Identification Technology - Information Management System, or AIT-IMS. This technology has interconnected nearly every aspect of Boeing's asset management and supply chain – not just at a single factory, but across more than 50 Boeing sites. Among its vast capabilities, the technology:

- Provides automatic notifications when an assembly arrives on the loading dock or is shipped by a supplier
- Monitors assemblies and equipment for improper handling, temperature extremes and pilferage
- Tracks packages, equipment, tools and parts as they move through the factory
- Automatically sends a request to accounting to pay the supplier for a part



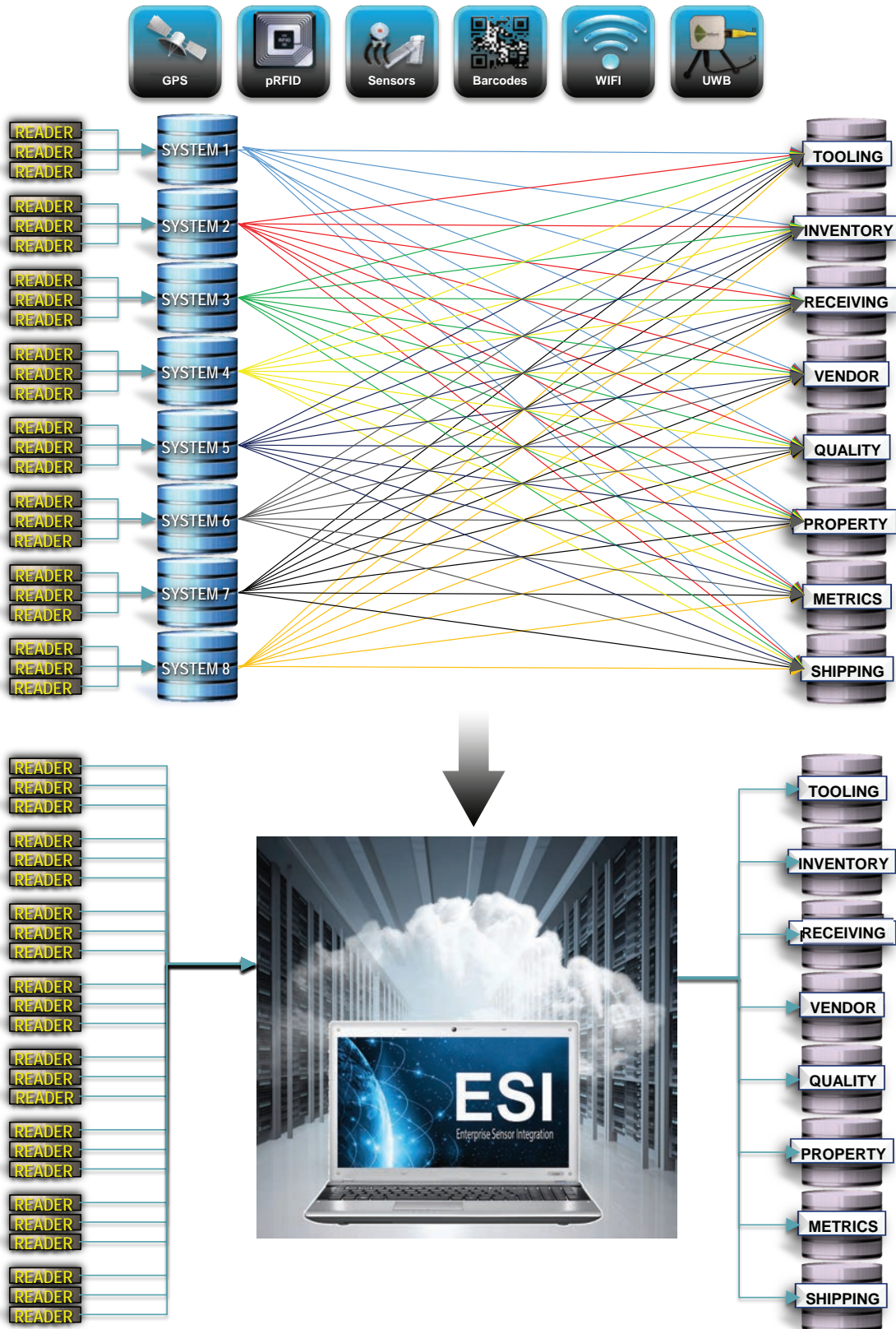
The sensor integration solution saved Boeing over \$100 million in its first year alone and continues to generate savings year after year. It has improved productivity, reduced inventory costs and increased supply chain velocity. With AIT-IMS, there is also better situational awareness and actionable decision-support capabilities as well as enhanced safety and security at the assembly plants.

As a result of AIT-IMS' successful implementation at Boeing, Tapestry launched the commercially available ESI product line in November 2016. Enhancements include a cloud-based platform and integration with sensors that detect temperature, pressure and humidity levels. ESI is scalable for enterprise-level manufacturing and supply chains as well as smaller factories.



ESI saved Boeing over \$100 million in its first year alone.

THE ESI SENSOR CONNECTION



*ESI connects disparate sensor technologies through a standard interface.
It integrates multiple data sources through a common infrastructure, regardless
of the hardware type, manufacturer or data format.*

CONNECTING THE ENTERPRISE

Boeing's Everett Factory in Washington State – one of the world's largest manufacturing plants – was the first factory in the U.S. that successfully implemented the sensor integration technology. The AIT-IMS solution was required to help manage and track assets during production of its jumbo jet aircraft. Effectively tracking assets is vital for the plant's efficient operation, but not an easy task for a plant that covers nearly 100 acres with over 30,000 employees.



Assembling an aircraft here requires millions of parts and in some cases, more than 500 suppliers. Hundreds of specialty tools and equipment are also required, as well as the right engineers and other skilled employees. All of these must come together in a complex and highly choreographed dance to assemble an aircraft. If critical components, tools and employees aren't ready precisely when they are needed, it can slow or halt a massive assembly line. An automated information system was clearly needed, not only at Everett, but across the Boeing enterprise.

THE IMPLEMENTATION

Like other large enterprises, Boeing has more than 100 systems in place to manage assets and workflow processes. Tapestry was tasked with fusing all these systems and sensors together – everything from active and passive RFID, Wi-Fi and GPS tags, scanners and ultra-wideband wireless systems – while ensuring interoperability with its Enterprise Resource Planning system.



Working closely with Boeing, Tapestry broke down the development of AIT-IMS in multiple phases. Tapestry was able to quickly design, develop and implement a smart solution that has yielded long-term operational efficiencies for the Everett plant and 49 other Boeing factories.

Today, the technology has given the Boeing factories a sensor- and hardware-agnostic integration platform that has significantly enhanced assembly processes and reduced operational costs.

Employees have an enterprise-wide, map-centric view of data pertaining to assembly schedules, quality control, location of assets and temperature regulation. Now, locating an asset takes no more time than loading AIT-IMS – even if it's thousands of miles away.

ESI POTENTIAL BENEFITS

■ COST SAVINGS

Substantial cost savings are realized with improved inventory control, and reduced asset misplacement and loss.

■ PRODUCTIVITY

Accurate, timely data improves production cycle time and equipment availability. Automated workflow processes mean fewer manual inputs and bottlenecks, and increased productivity.

■ ASSET VISIBILITY

Improved operational visibility with mapping applications. The system visually displays where an asset is located, anywhere in the world, on maps and building layouts when a part or tag number is entered in the system. ESI provides traceability and accountability for equipment and assets as they move through the factory floor.

■ DECISION-MAKING

Real-time data and analytics provide actionable information to decision-makers; problems can be addressed and mitigated before they affect the workflow.

■ STANDARDIZATION

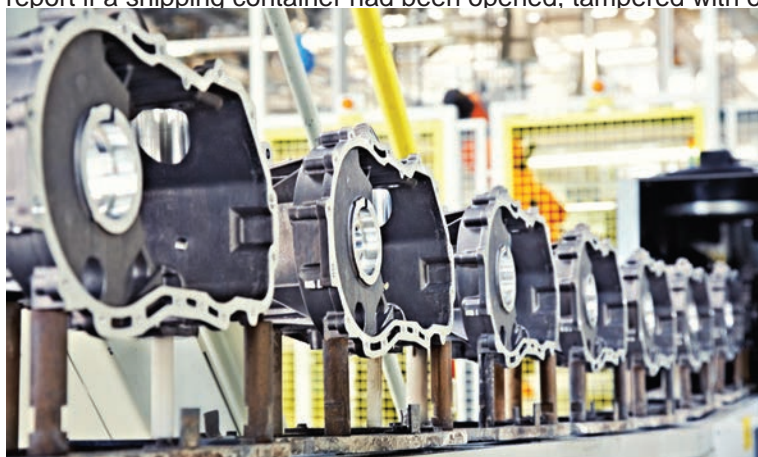
Standardization across the enterprise provides the platform for the Internet of Things.

■ SAFETY

Safety and situational awareness is enhanced with sensors placed at high-traffic intersections or other dangerous areas; warning lights and audible warnings alert employees as vehicles approach.

■ SECURITY

With real-time tracking and monitoring, assets can be protected from loss and theft anywhere in the world. A sensor will report if a shipping container had been opened, tampered with or detoured from its planned route.



IN SUMMARY

■ The fast-approaching Internet of Things (IoT), which is built on billions of integrated sensors and powerful computing, will bring dramatic changes to our homes, cities and workplaces.

■ The IoT is fueling the fourth Industrial Revolution, known as the Industrial IoT, which will significantly improve visibility on the factory floor, reduce down time and improve the bottom line.

■ The IoT revolves around connecting data from sensor-embedded devices and machines, which fuse Big Data in real-time to deliver powerful analytics.

■ The rapid rise of dissociated IoT sensors and systems has posed significant interoperability challenges for industries. Many IoT solutions are proprietary technologies, and are not designed for interoperability with other brands, data formats or legacy systems.



■ Tapestry Solutions has stayed one step ahead of the Industrial IoT with its Enterprise Sensor Integration solution, or ESI. The technology is based on a proven automated information management system that Tapestry implemented across 50 Boeing factories, including the massive Everett plant in Washington that assembles jumbo jets.

■ ESI is an innovative sensor-agnostic solution that combines disparate technologies on a common platform. It connects a myriad of sensors and devices, regardless of the make or model. ESI also integrates with legacy asset management systems.

■ ESI provides Boeing with the interoperable platform for the Industrial IoT. Its core technology saved Boeing more than \$100 million in its first year due to increased production, asset visibility and automated workflow processes. Tapestry estimates a recurring savings for Boeing of \$70 million annually.

■ ESI can unlock the potential to IoT for enterprise-level supply chain operations and smaller factories as well as defense logistics management.

Tapestry Solutions, Inc. is a global provider of information management software and services for defense, government and commercial markets. Backed by our parent company, The Boeing Company, we help solve logistics challenges for the world's largest and most complex supply chains. We also provide mission planning, training and simulation support to maximize readiness for our warfighters. Headquartered in San Diego, Calif., Tapestry supports customers from more than 50 locations around the world, including Saudi Arabia, Oman, Afghanistan, Kuwait, the UK, South Korea, Australia and Germany.