Industry 4.0 Is Transforming Supply Chains

What it Means for Your Business and How To Become Industry 4.0-Ready

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Introduction: What is Industry 4.0?

It's a hot term these days: **"**Industry 4.0." But what exactly is it? First defined in 2011 by Dr. Siegfried Russwurm, German professor and Chief Technology Officer of Siemens AG, Industry 4.0 refers to the fourth phase of industrial evolution—the coming of "cyber-physical" systems. This era is characterized by interconnectivity between equipment and facilities throughout supply chains made possible by the Internet. (For context, the first phase was mechanization driven by water and steam power; the second phase was electric powered mass production on assembly line; and the third phase was digital, representing the transition to computerized and automated machinery).

Industry 4.0 is a step beyond the digital era. In the digital era—in which many companies still operate—having data generated by and collected from discrete automated equipment is useful for determining both past and present operational states. These include performance trends and overall equipment effectiveness within a given, historic time period. However, most of the data is in silos, not easily accessed for analysis and certainly not passed among different systems automatically.

Conversely, although Industry 4.0 is also data-dependent, that data is more effectively utilized by leveraging the Industrial Internet of Things (IIoT). IIoT seamlessly connects industrial automation equipment and systems via the Internet. Supported by connectivity technologies embedded within previously isolated equipment and machinery—and ultimately between facilities and suppliers throughout a supply chain—companies can automatically gather and use information in ways that are not just informative, but also predictive, proactive and actionable.

Of particular note: a broad range of industrial sensors and automatic identification and data collection (AIDC) technologies are the linchpins of Industry 4.0. Detecting, measuring, capturing, recording, collecting and communicating the broad range of conditional data passed among and between industrial equipment, systems and facilities is not possible without these sensor systems. Today's sensors are more intelligent, more affordable, and offer more functionality than ever before. Further, many of these sensors offer wireless communication options through Bluetooth and other WiFi gateways—making them even easier to implement and their data easier to harness.

To achieve the benefits of an interconnected, Industry 4.0 supply chain, it is critical to select, install and configure an appropriate mix of intelligent sensor and AIDC solutions that enable automatic track-and-trace, product identification, dimensioning, safety, quality control and validation, vendor compliance, preventative maintenance, collision and obstacle avoidance, measurement, positioning and more. Through these enabling solutions, your company and its supply chain will be well on the way to operating in the era of Industry 4.0—using data to achieve a new level of functionality not available in the digital age.

What does Industry 4.0 mean for supply chains?

Industry 4.0-empowered supply chains are characterized by four capabilities:

- **Visibility** into operational status at the device level throughout all physical locations via real-time information collected and processed by intelligent sensors
- **Interconnectivity** of equipment, machinery, facilities and people for transparency throughout all levels
- **Autonomous performance** of equipment and systems to complete tasks as efficiently as possible with minimal human intervention
- **Predictive analysis** of all data to identify patterns and trends in inventory, purchasing, equipment usage and more, enabling proactive decision making

With these four capabilities in place, companies can more effectively manage their upstream vendor and supplier arrangements, as well as respond faster to unforeseen events within their supply chains, such as a spike in demand or disruptions due to weather events or political unrest.

Likewise, with a more holistic view backed by historic and real-time information, a more agile and resilient supply chain that minimizes time to customer delivery can be designed or reconfigured, inventories optimized, quality enhanced, and labor utilization and safety improved. Other data-driven, Industry 4.0 benefits include the ability to utilize better reporting tools for increased operator and equipment productivity, improved training practices, and reduced product damage.

Further, unscheduled machine downtime can be avoided through more accurate planning of preventive maintenance. Industry 4.0-enabled supply chains will ultimately generate better customer experiences, higher performance and greater cost savings—giving companies a competitive edge.

How will Industry 4.0 impact different industries' supply chains?

Industries that handle discrete products and parcels throughout their supply chains—such as omni-channel retailers as well as shipping and transportation service providers—will ultimately benefit from the increased transparency and visibility inherent to Industry 4.0. Below are a few potential scenarios.

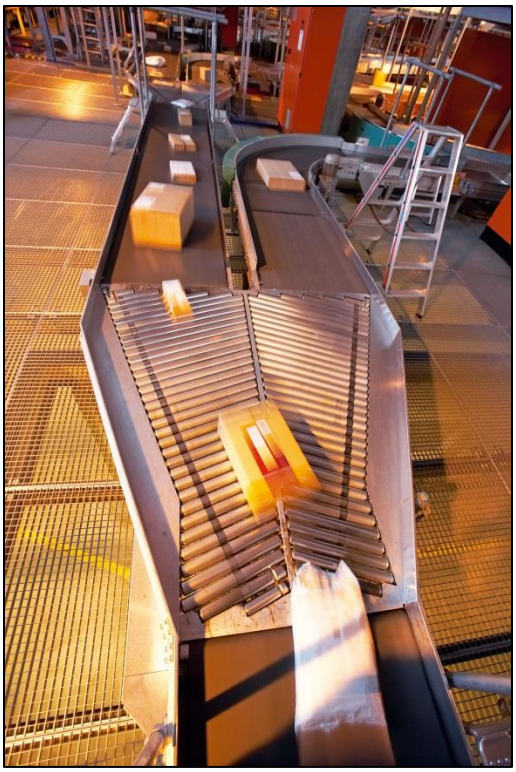
Omni-Channel Retail

For the various participants in retail supply chains—including brick and mortar retailers and wholesalers, e-commerce, third-party logistics (3PL) service providers, direct-to-customer sellers and reverse logistics processors—Industry 4.0 connectivity of systems, equipment, devices and facilities enhances every aspect of inventory and transactional management.

Retailers, 3PLs and wholesalers will gain better efficiency and greater cost savings for an increased competitive advantage. Data collected upon inbound receipt of cases, pallets and eaches is instantly and accurately captured and transmitted in real-time, allowing for better visibility into available stock and automated routing of inventory to the most appropriate storage medium. Physical and e-commerce retailers utilizing predictive analytics from their Industry 4.0 enabled supply chain can proactively (instead of reactively) align fulfillment resources to optimize delivery processes, re-routing overstock or additional inventory to replenish a store with higher demand, for example.

Further, with the information captured by intelligent sensors at various points through the supply chain, the print quality and placement of a label applied by automated print-and-apply labeling technologies can be verified prior to shipment or upon receipt. Retailers can use the resulting documentation data to hold suppliers accountable and enforce compliance that improves upstream processes.

Additionally, the Industry 4.0 consumer buying experience is superior. It allows purchasers instant access to information about what items are available in which location (physical stores or distribution centers), and in what size, color and quantity. Once the order is placed, the customer can easily query the system through the vendor's website to determine where within the shipping process their items are, and when they will be delivered. Should an e-commerce customer return a shipment, the status of the return and their subsequent credit reimbursement can be determined online without the assistance of a human customer service representative.



Package and Parcel Transportation and Delivery

Getting items from here to there—via express couriers, postal services, overnight carriers, ground, freight, overseas shipping, air, rail, and perhaps even drones—can be accomplished more efficiently and with higher visibility and greater transparency with Industry 4.0 connectivity.

With real-time visibility into the location of goods throughout the supply chain, shippers are better able to track-and-trace both assets and goods from supplier to consumer at any point in transit with better insight into process control. Through Industry 4.0-enabled data analysis, a variety of transit and process alternatives can be modeled and compared for determining the optimal method of shipping based on variables such as time, cost, customs constraints, tariffs and customer requirements. The optimal multi-stop route, pooling consolidation points, stop combinations and carriers can be automatically selected by the system utilizing sophisticated planning algorithms and data garnered from all points within the supply chain.

Additionally, detailed advance shipping notices (ASNs), purchase orders (POs) and electronic data interchange (EDI) status updates can be sent and responded to instantly, allowing for accommodation of late or inaccurate deliveries. Facilities with limited dock space better plan for arrivals of critical inventory, queuing those trailers ahead of ones with less time-sensitive inventory onboard. Vendor scorecards can be sent more frequently and instantly—weekly instead of monthly, for example—to highlight areas of concern and address carrier performance issue.

Further, sensor-enabled dimensioning not only of small parcels and cartons, but also of pallets and larger freight shipments ensures that shipments meet dimensional weight (DIM-weight) standards established by global parcel and express carriers. Chargebacks for shipper and/or vendor non-compliance can be validated or disputed with data collected by intelligent sensors.

How can you navigate to your supply chain's Industry 4.0 future state?

Achieving Industry 4.0 readiness can be a lot to process—literally. You might be wondering what actions your company can take to adapt your existing supply chain and navigate toward an Industry 4.0 operational state. Here are a few guidelines for consideration:

1. **Evaluate your current data capture processes.** If your data capture methodologies are manual, they likely won't be adequate to accommodate the real-time demands of an Industry 4.0-ready climate. Semi-automated or fully automated systems, on the other hand, do not require human interaction to trigger data capture and information transfer. Replacing manual operations with a degree of automation will not only boost throughput, but also increase accuracy and efficiency while reducing labor costs.

2. **Assess your customers' service level expectations.** Regardless of your company's place within the supply chain (manufacturer, wholesaler, distributor, e-commerce shipper, etc.), your downstream customers want visibility into their order, its location and its progress toward delivery. Without AIDC systems in place to support the interconnectivity between each piece of equipment and each facility, that degree of transparency within the Industry 4.0 environment cannot be achieved.

3. **Establish service level compliance requirements.** An Industry 4.0-ready supply chain relies on consistent, reliable and easily verified transactional information. That means the information marked on a carton must meet a certain level of readability by sensors. Hence, vendor compliance requirements must be established for code placement, legibility, intactness and other factors. Without adherence to minimum standards, automated devices won't be able to pull the data needed for autonomous operation or predictive analytics.

Clearly, then, the benefits of Industry 4.0 are empowered by a range of sensors and AIDC technologies. For data capture, there are three primary types:

Laser Scanners: With a 30-plus year implementation history, laser scanners provide the lowest cost means to attain consistent and high read rates of information encoded in linear, 1-dimensional barcodes (patterns of dark and light spaces, such as UPC, EAN, Code 128, Code 39 and Interleaved 2 of 5). Today's laser scanners can capture data at rates of 1,200-plus scans per second, making them suitable for high-speed applications up to 700 feet per minute. Cost-effective, a single laser scanner can provide a very wide area of coverage and depth of field, identifying a single carton by its UPC code or installed in multi-unit systems configured to read multiple planes of a carton or parcel (omni-directional coverage).

Image-Capture Cameras: Capable of reading both linear, 1-dimensional codes, as well as the newest matrix, 2-dimensional codes that encode data into round or square patterns of dark and light dots (PDF 417, DataMatrix, Maxicode and QR code), camera systems come in two configuration types. The first, area-array cameras, utilize a two-dimensional imager to capture a full image of an entire region at one time—similar to a snapshot taken with a digital

camera. The second configuration, line-array cameras utilize a 1-dimensional array of pixels on the sensor to progressively acquire slices of the image as the item moves past. This technology produces incredibly high-resolution images, even at very high transport speeds; certain devices are capable of 30,000 scans per second.

Radio Frequency Identification (RFID): Ultra high frequency (UHF) RFID employs tags at the item level with data embedded in a microchip attached to a small antenna. RFID readers transmit an electromagnetic field to capture tag data. Because it relies on radio frequency technology, RFID does not require direct line-of-sight to read the data, and it can identify a variety of objects in a single read operation simultaneously. Indeed, RFID enables fast, accurate verification of case packed inventory without opening the box. Likewise, RFID can be used to track the location of mobile assets, either within a facility (such as a forklift) or in transit over the road (in a tractor trailer).

Beyond the AIDC sensors described above, there are a host of detection and measurement sensor technologies also available to capture and communicate the data demanded by Industry 4.0. These include:

Automatic Object Detection Systems: Photoelectric sensors detect the absence or presence an item by transmitting of a beam of light to a receiver. The beam of light must reflect off the object back to the receiver to be detected. Alternately, ultrasonic sensors generate high frequency sound waves that bounce off an object back to the sensor, indicating its presence.

Impact Detection Systems: These sensors detect the frequency, severity and velocity of an impact from a moving object, which can be used either for data analysis or to prompt an alert for corrective measures. When used with forklifts, an impact alert can trigger a fault that generates a work order for repair or service.

Stability Control Systems: Typically mounted on mobile systems, including forklifts and AGVs, these safety sensors continuously monitor the vehicle's speed, turns, and forward or reverse travel to detect conditions that might lead to instability and increase the potential for a tip over. The collected data is routed to an on-board computer system that processes and analyzes it in real-time. When the sensor detects a particular preset trigger point or threshold, the vehicle's control system automatically activates a corresponding stabilizing correction to regain control.

Distance Measurement Systems and Encoders: Distance sensors project a laser beam spot of light onto a point. The light is reflected back to the sensor, which calculates the point's position through triangulation for automatic determination of an object's location. These sensors are typically installed in automated storage and retrieval systems (ASRS) to assist with storage of products and totes, and for autonomous, natural feature navigation of automatic guided vehicles. In addition, encoders offer precise position

detection as well as accurate measurement of revolutions, rpm, speed and acceleration for mobile systems.

Volume Measurement Systems: Installed as part of a standalone system or integrated in-line with conveyor, volume measurement sensors determine the length, width and height of an object to calculate volume and detect irregularly shaped objects. At the point of receipt, capturing an item's dimensional data helps an automated storage and retrieval system determine the optimal storage location; when shipping, dimensional data can be used to optimize secondary packaging to reduce carrier charges or for load optimization applications.

Weighing Systems: By measuring the amount of pressure exerted by an object or load, pressure sensors provide either a primary determination of weight, or a secondary verification of the weight—such as when recorded by an on-board forklift scale. Weigh scales can be installed as part of a standalone system or integrated in-line with conveyor for automatic weight capture on the fly, and are frequently used at outbound packing and shipping docks.

Take your next steps into Industry 4.0 readiness…

Unsure which intelligent sensor systems—or combination of technologies—are best suited to bring your supply chain into the Industry 4.0 era? The ideal suppliers have the ability to both supply and implement connected solutions that enable automatic track-and-trace, product identification, dimensioning, safety, quality control and validation, vendor compliance, preventative maintenance, collision and obstacle avoidance, measurement, positioning, and more.

By leveraging the optimal sensor technologies, your operations will gain a competitive edge through enhanced visibility, interconnectivity, autonomous performance and predictive analysis. In addition to realizing greater operational efficiencies, Industry 4.0-ready supply chain participants will improve interactions upstream with vendors and suppliers, and downstream to your customers and end users. Companies that choose to harness the power of their information by leveraging Industry 4.0 to make predictive, proactive and actionable decisions are the ones that will lead this new cyber-physical era.

For more information about Industry 4.0 and its implications for the supply chain, please contact your local SICK sales representative, or email us at info@sick.com. You can also visit our website at www.sickusa.com

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