How Intelligent Sensor Solutions Turn Data Into Action

Cloud-ready sensor technology enables higher volume, greater visibility and transparency, and more accountability in your fulfillment center or DC.

A popular word game asks players to describe something—a lifelong goal, their hometown, themselves—in five words or less. Now suppose distribution center (DC) and fulfillment center (FC) managers played the game, but instead the question was: Name your most important business requirements in five words or less. It's difficult to distill such complex topics into so few words, but for many, the answer might go something like this: *volume, visibility, transparency, accountability, profitability.*

Why do those particular concepts matter so much to DCs and FCs? They allow companies to not just respond, but also to thrive amid today's most challenging trends. A short list includes:

- Continuing, rapid growth of e-commerce in a widening range of industries;
- Explosive increases in order volumes and throughput requirements;
- Product-mix changes and variability in order profiles;
- Consumers' and industrial buyers' expectations for a uniformly exceptional buying and delivery experience; and
- The need for more—and more sophisticated—logistics automation and data collection to ensure fast, accurate order fulfillment.

The COVID-19 pandemic has exacerbated some of those trends; it also reinforces the importance of being able to detect, analyze, and quickly respond to rapid, often unexpected change. Indeed, if all of this could be summed up in *one* word, it would be CHANGE.

In this uncertain environment, fulfillment centers and DCs must ensure customers' satisfaction while supporting the company's ability to be competitive and profitable. Yet they're finding it difficult to meet those demands and expectations. What's holding them back? Inadequate or outdated equipment and software that cannot stay ahead of volume growth; facilities that were not designed for today's high-volume, high-speed demands; a labor shortage that's been exacerbated by the pandemic ... and above all, a lack of real-time data that can tell them exactly what and where something is happening, as it happens.

Intelligent sensors can help distribution and fulfillment centers meet those challenges, by allowing them to collect, connect, and leverage real-time data to make smart, proactive decisions. SICK is a global thought leader in this area: Its cloud-ready sensor solutions go beyond the traditional "what"—documenting current status and activity—to encompass the "why" and "how"—identifying the source of a problem and enabling a swift resolution. These capabilities provide the insights DCs and FCs need as they continue to navigate Industry 4.0, the fourth Industrial Revolution.

PROBLEM:
Slow response to jams

Jams develop at such locations as sorter induct lanes and receiving spur lanes. When labor fails to address jams quickly, volumes at inbound receive sorters, parcel identifiers, and unutilized downstream conveyances are affected.

VISIBILITY: The IO-Link network mirrors real-time photo-eye sensor data on jammed condition; internet gateway posts data to the cloud. Web service generates HTML5 dashboards that are visible to facility operations and corporate supply chain teams.

ACCOUNTABILITY: Jammed-lane sensor data generates unsolicited messages instructing maintenance/operations to address impediments; also tracks time until resolution and lost-volume KPIs.

THE FUNDAMENTALS

The main types of sensors used in DCs and FCs can be grouped within five functional categories:

1. **Detection:** Senses the presence of objects and measures distances and heights on equipment such as conveyors and sorters.
2. **Identification:** Uses image-based and RFID automatic identification systems to track and trace objects as they move through the supply chain, for example, at packing stations and loading/receiving docks.
3. **Qualification:** Determines object dimensions, calculates volume, and detects damage to goods in a variety of situations, including automated palletizing/depalletizing, packaging selection, and load and storage optimization.
4. **Positioning:** Verifies that objects meet positioning requirements for transport units, such as automated storage and retrieval systems and automated guided vehicles.

5. **Protection:** Keeps people, products, and equipment safe with photoelectric safety switches, laser scanners, and other safety-enhancing technology.

Earlier generations of sensors were designed to detect an activity or condition, and to collect historical data. Now, as businesses digitize, they need something more: sensors that can not only collect and wirelessly transmit raw ("unfiltered") data, but can also organize, process, and share it as usable information, in real time. The path from unfiltered data to actionable information begins with sensors collecting data about the objects at hand. Embedded software wirelessly transmits encrypted data among internet-enabled, "connected" material handling equipment, such as conveyors, sorters, bar-code readers, and camera tunnels, and to/from a central processing system in the cloud.

"The cloud" is a kind of shorthand for data storage and processing conducted through the internet on networks of servers, explains SICK's Sourabh Banerjee, Market Product Manager, Systems and Software. It offers many advantages over local infrastructure models, including greater processing power, the capacity to send massive amounts of data over the internet for centralized processing and storage, and the ability for authorized users to access information from anywhere, at any time. Critical in these uncertain times is what Account Executive, AWS Solutions Architect William Colwell refers to as "the elastic nature of the cloud." A cloud server network senses demand and delivers the amount of processing and storage capacity required by the customer, charging only for what is actually used, he explains. Moreover, cloud servers are maintained by a host service, so customers do not need to update hardware or software themselves.

PROBLEM:
Ignored full-lane conditions

Labor falls behind in pallet builds, fluid loads, and package collection; takeaway lane is full and sorter can't discharge, causing product recirculation and upstream backups.

VISIBILITY: The IO-Link network mirrors real-time photo-eye sensor data on full-lane condition; internet gateway posts data to the cloud. Web service generates HTML5 dashboards that are visible to facility operations and corporate supply chain teams.

ACCOUNTABILITY: Full-lane sensor data generates unsolicited messages instructing maintenance/operations to address impediments; also tracks time until resolution and lost-volume KPIs.

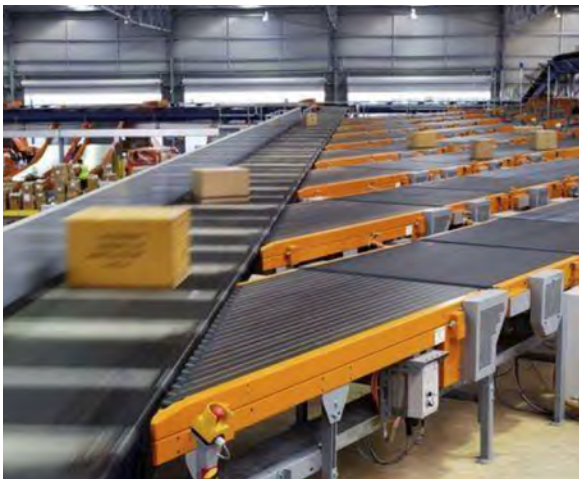
Sensor data moves to the cloud through a web service, defined by IBM as a software system that supports machine-to-machine interaction over a network. Web services fulfill specified tasks, using standard XML language to provide information, such as real-time messages sent via text, email, and other means.

Typically, web services and cloud infrastructure are purchased and controlled by the customer. However, customers have the option to utilize SICK's own offerings. SICK ensures that the data is in the cloud and accessible to the customer; it can also establish HTML5-based dashboards that help customers define and retrieve insights from sensor-generated data. When that data is combined with cloud-based artificial intelligence and machine learning, users can not only analyze the "here and now," they can also predict what will happen and prescribe actions to optimize efficiency and throughput.

"Edge" computing—where decisions are made in real time at the device level—is quickly gaining traction as DCs and FCs recognize its advantages. One example is SICK's label checker. Its software-equipped camera uses optical character recognition (OCR) to determine whether labels meet user-specified standards, checking bar codes, date codes, symbols, and the like, and deciding to allow a carton to proceed or divert it for correction.

THE BENEFITS

Pressure is ramping up on DCs and fulfillment centers to perform perfectly even as volumes soar. There's no room for error—or for delays or bottlenecks of any kind. In this demanding environment, real-time, sensor-generated data is a must-have. "If I can guarantee that data is accurate, then immediate action can be taken based on that information while [an order] is in motion," Banerjee says. "Real-time data allows everyone to make decisions and take action in the shortest span of time."



PROBLEM:
Inefficient sorter induction

Sorter releases slugs fed by fixed length of accumulation conveyance. Process repeats consecutively for each induct lane, causing upstream and downstream volume losses.

VISIBILITY: SICK's FlexChain sensors more efficiently determine carton and tote locations to support traditional lane accumulation function. Sensors collect granular data showing how much of the induct accumulation conveyance is being utilized.

ACCOUNTABILITY: Data lets sorters continuously induct lanes with maximum possible cartons or totes, reducing volume loss by improving upstream/downstream conveyor usage.

Importantly, real-time sensor data can help prevent problems from multiplying or perpetuating. For example, metrics might show that only 85% of the day's orders shipped as planned, creating a backlog that will impact operations for days to come. With manual or batch data collection, the magnitude and source of the problem will only be evident after the fact. With real-time data from sensors, by contrast, facilities know when a problem is developing and can immediately identify the cause and correct it. The advantages are clear. "If a facility is operating even for a minute in a condition that's not optimal for moving volume, then it loses volume," Duncan points out. Any loss, however small, will compromise profitability, especially in e-commerce, where a late shipment can mean a lost customer.

Real-time data underpins the five critical business requirements for DCs and fulfillment centers mentioned previously: *volume, visibility, transparency, accountability,* and *profitability.* We've just touched on volume and profitability; here is a closer look at the others:

Visibility is the ability to see data generated by sensor devices and other sources. This data should show, in real time, what is happening and where. Additional value accrues when analytical software measures data against key performance indicators (KPIs), allowing stakeholders to identify any problems that might be brewing and take preventive action.

Transparency makes data and related insights available

to multiple decision-making levels. For example, SICK's optional customer dashboards allow corporate management to view data at the same time the facility does, providing information for both operational and strategic decisions.

Accountability refers to communicating information to ensure that prescribed actions are being performed. Consider the example of a DC that needs to increase volume. Using automated cloud tools, managers can see in real time where volume has been compromised, for instance, by a jam in a specific part of a conveyor. SICK software in the cloud will identify the problem and send unsolicited messages to the appropriate team; if the problem has not been resolved by the expected time, an alert is sent to management, which can then ensure resolution.

Let's take a look at some real-world examples that highlight these benefits in the logistics environment, specifically in the common problem areas of conveyors, sorters, and labor.

PROBLEM:
Poor gapping

Improper gapping of cartons, totes, and bags results in sorter side-by-sides, conveyance jams and stoppages, and potential safety events.

VISIBILITY: SICK's FlexChain sensors monitor current gapping values and support proper accumulation; maintenance and operations teams gain visibility needed to quickly address gapping issues.

ACCOUNTABILITY: Reducing side-by-sides improves sorter efficiency and reduces costs associated with shipping to wrong destinations; minimizing jams and gaps improves volume.

CONVEYORS

Jams—when items that are damaged, are improperly spaced, or shift as they travel pile up in tight spots—are a common cause of volume loss. Another is full-lane conditions, which occur when workers fail to unload a takeaway lane quickly enough, and the sorter cannot discharge to that lane. Conveyances slow or stop, goods are damaged, and backlogs develop upstream.

When operators don't acknowledge and clear or report holdups immediately, conditions quickly worsen. SICK helped solve that problem for one customer by eliminating its reliance on person-to-person communication. Instead, full-lane data from photo-eye sensors instantly transmits to the customer's cloud, where supervisors can view it in dashboards and the solution generates messages with instructions to address the volume impediment. The sensors also feed real-time full-lane data to a programmable logic controller (PLC), which then diverts items to another takeaway. Historical information—how long was the lane full, how long after the message was sent did operators respond, how much volume was lost, and so forth—allows managers to identify patterns and prevent future problems.

SORTERS

Many sorters experience inefficient induction. Each induct lane typically releases a "slug," or group of items, at specified intervals. The slug is fed by a fixed length of accumulation conveyance, and the process is repeated for each lane, in a consecutive, "round-robin" pattern. Too large a space between slugs causes volume losses both upstream and downstream. To address that, SICK's FlexChain sensors identify carton and tote

locations and collect data showing how much of the induct accumulation conveyance is being utilized. Sorters can then be adjusted to induct lanes with the maximum number of cartons or totes possible.

FlexChain technology also provides the necessary visibility to quickly resolve jams, stoppages, safety events, and improper separation, or "gapping," of cartons, totes, and bags. Improper gapping leads to "side-by-sides," where two items occupy a cell at the same time, causing costly errors such as missed or incomplete scans, incorrect shipping destinations, and unnecessary recirculation.

The inefficiencies described above may also result from maintenance issues. SICK's MSC800 controller can help by sending KPI data from scanners and cameras, such as no reads, multi-reads, side-by-sides, and more, to the cloud, where customers can monitor a dashboard for problems. An extra "layer" of protection: SICK's Remote Service Connect support lets qualified experts remotely monitor and diagnose programmable sensors to make authorized changes or guide local technicians as they conduct repairs. The service also provides predictive analytics reports to support preventive maintenance.

LABOR

No matter how much automation they deploy, DCs and FCs still depend on people to reliably handle critical responsibilities. That doesn't always happen, though. SICK's sensor solutions can help.

PROBLEM:
Slow updates to maintenance planners

Side-by-sides, no-reads, and low read counts may be caused by maintenance issues, but it's difficult for local support teams to identify problems in complicated systems like sort controllers and associated scanners and camera tunnels.

VISIBILITY: SICK's MSC800 controller sends data on no-reads, multi-reads, side-by-sides, hardware failures, last gap, label location, read counts, and cabinet conditions to the cloud. Dashboards display scanner and camera KPI data.

ACCOUNTABILITY: SICK's Remote Service Connect predictive analytics service provides up-to-date reports on tunnel efficiency and any problem affecting read rates; remote support monitors and diagnoses sensors, and can make authorized changes or guide local technicians.

For example, when associates don't receive the supplies they need for activities like picking, packing, and decanting, their productivity will be substantially reduced. Local solutions for calling attention to shortages, such as stack lights, are often ignored. To ensure a quick response, I0-Link communication technology collects associates' requests, and its internet gateway immediately pushes that data to the customer's cloud. From there, unsolicited messages alert the operations team to the requests. To support predictive supply purchases, cloud tools can track consumption and forecast demand.

Most facilities station associates at strategic locations to make sure equipment is working properly. To protect both the asset and throughput volume, the location must be monitored consistently. When associates fail to do so, carton and tote backups, full-lane conditions, and conveyance damage from jams can quickly develop. In a large facility, though, it's difficult to know whether a person is (or isn't) at a critical location. SICK's LiDAR sensors can be programmed to detect a worker's presence or absence and send a signal to the cloud or to a

local supervisor. Simultaneously, the sensors protect associates' safety by tracking their positions relative to mobile equipment.

A PHILOSOPHY FOR THE FUTURE

The pressures facing DCs and FCs today—the growth of e-commerce, soaring order volumes and throughput, variability in product mix and order profiles, expectations for a perfect buying and delivery experience, and the need for more automation to guarantee fast, accurate order fulfillment—are sure to intensify. Intelligent sensor solutions will be critical for meeting those demands, by showing, in real time, not just what is happening, but also where and why a problem is occurring. With that information in hand, facilities can immediately take corrective action. Cloud-based analytical tools will convert sensor data to predictive and prescriptive information that can inform both operational decision-making and strategic planning.

Sensor solutions that provide visibility, transparency, and accountability will support distribution and fulfillment centers as they continue their Industry 4.0 journey. A key element of I4.0 for DCs and FCs is internet-enabled devices and material handling equipment that interact with and control each other, allowing an entire facility or a group of machines to "think" and operate like a single entity. Banerjee likens such connected equipment to the organs of the human body: If one of them is not integrated into the body's circulatory and nerve system, he says, then "that part will not function, and the brain can't make a decision." Whether the "body" is a manufacturing plant, an FC, or a DC, it's critical to understand which systems will impact the operation.

PROBLEM:
Associates with inadequate supplies

Associates lack essential supplies like cartons, tape, and dunnage for picking, packing, and decant activities, but local systems designed to alert supervisors of a shortage are often ignored; productivity falters while associates wait for refills.

VISIBILITY: The IO-Link network collects associates' requests for supplies and its internet gateway pushes them to the cloud in real time. Dashboards are visible to facility operations and corporate supply chain teams.

ACCOUNTABILITY: Data generates real-time unsolicited messages instructing operations to address supplies and labor issues; also tracks supplies consumption for predictive purchases.

As industries and the pressures on them change, visibility goals also change, and strategic applications of technology evolve along with them. "I4.0 is not just about being connected," Banerjee says. "It's also about being adaptable to different ways of solving problems to meet changing business requirements." Salim Dabbous, Director of SICK's Sensor and Safety Integration Team, agrees. It's important, he says, to recognize that Industry 4.0 is not just a collection of technologies and connected pieces of equipment; rather, "it is a philosophy, and a systemic way of thinking."

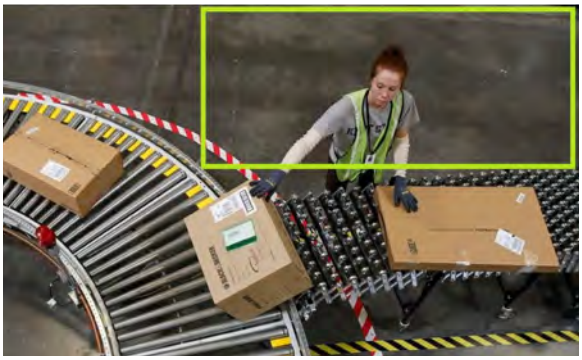
With that in mind, what can DCs and FCs do now to competitively position themselves for the future?

1. Become well versed in emerging technologies that could improve operations and provide a competitive advantage. Examples include robotics, cloud computing, edge computing, artificial intelligence and machine learning, and

machine-to-machine communication.
2. Ensure infrastructure can support those technologies; for example, IT systems must be robust enough to handle huge amounts of data.
3. Invest in the talent required to benefit from these technologies. Data scientists, IT operations analysts, and hardware, software, and other engineers will be in high demand. A labor and technical-skills shortage may require retraining an existing labor force.
4. Have a trusted cybersecurity team in place to provide confidentiality and integrity while achieving the appropriate balance of data security and availability.

Distribution and fulfillment centers seeking to maintain peak performance in the face of growing volumes must be able to anticipate and quickly respond to change. In fact, real-time sensor-generated data and the insights it provides are indispensible tools for keeping a competitive edge. In an increasingly connected world, a facility without them will be left behind.

For more information about SICK intelligent sensor solutions for logistics automation, visit www.sick.com/us/en.



PROBLEM:
Unattended strategic locations

Workers assigned to monitor strategic locations are not consistently present, leaving equipment vulnerable to product backups, jams, full-lane conditions, and conveyance damage.

VISIBILITY: SICK's family of LiDAR sensors monitor and track associates' presence in critical areas. LiDAR simultaneously protects them from contact with mobile platforms.

ACCOUNTABILITY: System can generate unsolicited alerts and provide labor-related dashboards visible to facility operations and corporate supply chain teams.

Sensor and Safety Integration: Navigating the Potential of I4.0

While SICK is known worldwide as a provider of advanced sensor hardware and software, the company does not stop there. Its Sensor and Safety Integration (S&SI) organization enhances SICK's traditional service and support capability with deep expertise in industrial automation, installation, and commissioning of sensor and guidance solutions for applications ranging from safety and preventive maintenance to material handling automation, including conveyors, sorters, picking robots, autonomous mobile robots (AMRs), automated guided vehicles (AGVs), and more.

One of S&SI's primary missions is to support customers as they seek to leverage the latest opportunities presented by Industry 4.0. Whether the assignment is to integrate sensors into a customer's existing process or one that SICK designed, to make more data available to improve visibility, or to create connectivity among unconnected material handling equipment, S&SI is up to the challenge, says Director Salim Dabbous. For example, a customer might want greater visibility to a group of machines operating on different technology platforms. S&SI will create a "bridge" between the existing hardware as well as a common methodology to collect the data, then bring input from the sensors up to the cloud. From there, S&SI's experts can help customers filter and leverage the data and information from the devices, through an analytics platform, application programming interface (API), artificial intelligence, or other engine. "We help customers navigate all the way through their visibility journey," he explains.