Continuous Improvement in the Supply Chain

Global Quality & Compliance Services for the Food Industry

SENSITECH

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A Carrier Company

Quality breaks down when the cold chain breaks down

Risks of improper temperatures in the supply chain are increased because perishable foods in transit are handed off so frequently. Each time fresh food products pass from one place to another—whether it's from grower to shipper or from distributor to retailer—there is an opportunity for a break in the cold chain to occur. In fact, cold chain issues can increase exponentially throughout the transportation link of the cold chain, resulting in costly rejected shipments.

Breaks in temperature control can occur for a wide variety of reasons. They could be due to operator error, either mistakenly, or in some cases purposefully, through an attempt to save time or money while en route or waiting to be unloaded. There are situations, for instance, when a driver attempts to conserve fuel by raising or lowering temperatures, and even though it may be slight, any variation in temperature can compromise product.

Additionally, breaks in the cold chain occur when there is insufficient pre-cooling, or poor or untimely loading practices. Equipment issues, such as inadequate insulation or improperly functioning refrigeration equipment, can raise temperatures even a degree or two and cause problems.

These disruptions contribute, both individually and collectively, to food spoilage, resulting in conditions such as moisture loss, discoloration, flavor and textural changes, breakage susceptibility and more.

Therefore, to maintain product quality and reduce waste and loss within the cold chain, companies must invest in a proactive continuous improvement program that monitors temperature compliance and corrects potentially costly variances during transport. Only through this kind of rigorous and ongoing visibility can product quality be ensured and protected.

What is proper cold chain management?

Sub-optimal temperatures can result in the loss of perishable foods, although the consequences of improper temperature management may not become apparent until the food is on the store shelf or in the hands of consumers. At that point, poor quality products result in consumer dissatisfaction, which impacts not only the specific purchase, but the reputation of the store brand.

To avoid such loss, there are four critical cold chain management steps that, when followed consistently, can significantly reduce the number of alarmed or rejected shipments and the costs associated with them.

1. **Cool** products properly before loading, so that they are at or near ideal temperature. Check throughout the core and corners of pallets—top, middle and bottom—with probes to ensure all the product is at the ideal temperature, which can then be maintained during transportation.
2. **Prepare** the shipping containers properly; ensure they are clean, in good repair and pre-cooled. Make sure they are programmed with proper temperature set points and reefer modes.
3. **Load** the container properly, with pallet heights that do not exceed height limits or interfere with air chutes. Leave space between pallets and the container walls, and put load locks in place if needed.
4. **Maintain** the proper temperature during transport and for the duration of the shipping and docking period through proper sealing, temperature control and air flows.

When product quality is compromised in the supply chain, it is almost a given that there is a breakdown in one of these steps. Better control—with a proactive focus on reducing variation in the process—can lead to reduced alarms and rejections and increased quality and efficiency.

Supply Chain Visibility through Continuous Improvement

By understanding the impact of time, temperature and location as food is transported to and from distribution centers, food retailers can gain supply chain visibility that helps them maintain the quality of temperature-sensitive perishable products.

Without a systematic strategy for cold chain monitoring and management, temperature-abused products can make it through the entire supply chain—and there could be costly ramifications.

A continuous improvement program that uses Good Cold Chain Management Practices (GCCMP) provides continual oversight, maintenance and control of proper temperatures. It includes a comprehensive plan with quality and product safety controls that detect short-term tactical problems and identify systemic issues, weaknesses, trends and root causes in each phase of transportation. And, most importantly, continuous improvement programs uncover what are often difficult-to-discover opportunities for remedial actions that drive efficiencies and cost-effectiveness.

An ongoing commitment to such a program helps food retailers achieve:

- Greater product quality and value
- Reduced product losses and waste
- Improved cost savings
- Better brand equity

The Sensitech Approach to Continuous Improvement

Sensitech is a global leader in supply chain visibility solutions that track, monitor and protect products across the entire cold chain for companies in the food, life sciences, consumer goods and industrial markets.

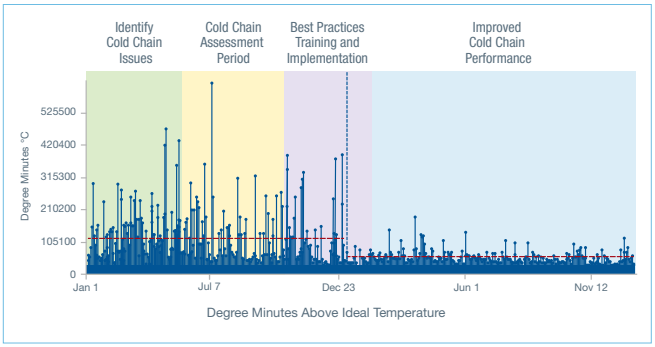
Our unique global continuous improvement programs for food growers, shippers and retailers combine technology, data analytics and multi-disciplinary expertise in a unique and unrivaled manner. We work with 18 of the top 20 food service providers and retailers in the world and help them identify opportunities for increased product quality through corrective and preventative actions (CAPA) as governed by the food industry.

Through these programs, our customers identify cold chain issues and take corrective actions to ensure consistent quality and create efficiencies that reduce costs and product loss.

From storage and distribution to supermarkets and food service retailers, we help our customers:

- Track and monitor temperature-sensitive perishable food products as they are stored and in transit.
- Ensure compliance from suppliers and distribution centers.
- Provide notifications in real-time to stop problems before they escalate.
- Evaluate processes throughout the global supply chain to identify systematic weaknesses, variability and root causes.
- Recommend corrective and remedial actions to fix issues.
- Monitor improvements to ensure continuous increase in supply chain performance.

Continuous Improvement Over Time



Continuous improvement benefits:
Less product loss or waste and improved operations with better work flow, more informed decisions, and performance-based accountability.

At the heart of our program: Sensitech Global Services Team

To achieve the rigor required by a continuous improvement program, we offer our food industry customers the extensive expertise and resources of our Sensitech Global Services Team of dedicated, world-class professionals.

This team combines its strong food industry expertise and supply chain best practices with state-of-the-art monitoring technology and analytics to help food producers, shippers and retailers ensure the quality and freshness of food products worldwide.

The skills of these world-class professionals go beyond the basic food quality and safety requirements. They have wide-ranging supply chain experience and industry knowledge that ensures the greatest return on a continuous improvement investment. And they provide the expertise and insight needed to drive process enhancements that can dramatically improve a customer's bottom line.

Collectively, our Global Services Team works closely with our customers to:

- Assess and analyze existing practices to see how they align with the four critical steps of cold chain management (cool, prepare, load, and maintain).
- Train suppliers and distribution centers in the cold chain management steps.
- Evaluate monitoring processes and standard operating procedures effectiveness in order to discover troublesome trends and patterns within the supply chain.
- Uncover root causes of cold chain issues and identify how to improve processes, quality and compliance.
- Identify the corrective actions that remediate issues and provide continuous improvement over time.
- Increase quality and profits while reducing costs.

Sensitech Global Services for the Food Industry

Program Management

For each customer, there is a dedicated Program Management Team that oversees every facet of a Sensitech Continuous Improvement Program.

- A Program Manager leads a team of experts that have the knowledge needed to optimize every aspect of the perishable food supply chain.
- The Program Management Team has expertise in end-to-end program and project management, data collection and analysis, customer support, and technology services.
- They deliver application engineering, deployment and integration support; customized reporting and analytics; data management services; training; and technical and client support services.

Industry Expertise

To fully execute continuous improvement for customers, Sensitech provides on-staff industry experts for consultation. These professionals are food scientists, computer scientists, industrial engineers, validation engineers, and post-harvest horticulturalists. There are specialists in logistics and packaging, as well as statisticians. These professionals deliver insights and expertise in the following areas:

- Food production
- Perishable products
- Refrigeration
- Storage cooler and freezer management
- Freezing and cooling equipment operation
- Distribution
- Logistics and transportation management
- Marine and air transportation
- Loading and unloading practices
- Global compliance
- Standard operating procedures (SOP)
- Quality assurance

An Overview of Our Services

Through our Continuous Improvement Program, the Sensitech Global Services Team assists customers in evaluating and improving their cold-chain processes. We offer services that include overall cold chain management, targeted project work to identify issues and proactive program data analysis to drive corrective actions.

Cold chain management

When a food retailer implements a Continuous Improvement Program with Sensitech, we start by working with the company's suppliers and distribution centers to set up comprehensive temperature-monitoring programs. We provide the temperature-monitoring equipment, software, data collection methods and proper program training that ensures the customer's specific goals are met.

Here are a few of the options customers can choose from, depending what key performance indicators (KPIs) they want to meet:

- The ColdStream® Inbound Program combines temperature data collection with data management, analysis and reporting to identify cold chain issues.
- ColdStream Inbound Real-time is an innovative program that provides full cold chain visibility—including both temperature and location—in real time. Cold Chain Logistics Services help with the challenges of managing the complex supply chains associated with export shipments. These services combine electronic monitoring, data management, analysis and reporting to help customers more effectively and efficiently manage their cold chain worldwide.
- ColdStream Site Services provide automated temperature monitoring and documentation of storage facilities and equipment. This service provides flexible, wireless temperature sensing of refrigerators, freezers and cold rooms with automated record-keeping and reporting. It eliminates manual processes while ensuring compliance with Good Manufacturing Practices (cGMP).

Issue identification

As a result of implementing a comprehensive temperature monitoring program, not only can cold chain issues be uncovered, but Sensitech can help customers discover exactly where and when issues occur. These services are key to any continuous improvement program and they may include:

Temperature-sensitive supply chain assessments

In these programs, our Services Team examines, evaluates and documents internal and external practices as they relate to proper and compliant product storage, handling and distribution. These assessments provide opportunistic temperature monitoring, thorough trailer and facility inspection and actionable process improvement recommendations. Each one is customized to meet the specific needs and objectives of each customer, with the goal of identifying thermal compliance gaps and opportunities for improvement. For instance, an assessment can include the overall evaluation of global supply chains over multiple seasons, or it can be tailored to evaluate a specific supplier, trade lane, product, location or other variable.

Thermal mapping studies

We help companies create temperature profiles and identify variations within any storage or transportation location, including facilities, trailers, intermodal containers, or air cargo holds.

Shipping studies

In addition to the above services, we provide ambient thermal profile development studies that measure product temperatures within predefined specifications. We also conduct performance studies to evaluate if specific shipping systems maintain the proper temperature as per design specifications and requirements in an actual distribution environment.

Site automation

Our Services Team also helps customers automate the temperature monitoring and documentation of their storage facilities and equipment to ensure compliance with Good Manufacturing Practices (cGMP). As an example, flexible, wireless temperature sensing tools with automated record-keeping and reporting capabilities can be placed into refrigerators, freezers and cold rooms.

Corrective action

Once our Service Team identifies root causes for alarmed or rejected shipments, our food industry experts provide recommendations to customers on what corrective actions they should take to rectify the problems. After these remedial steps are taken, ongoing monitoring and evaluation of processes can be put in place to ensure consistency and continued improvement.

The Continuous Improvement Framework

A Sensitech Continuous Improvement Program provides visibility through factual data that allows retailers and suppliers to work together with us to proactively manage their supply chain and prevent future issues from arising.

The deliverables in our Continuous Improvement Program are based on a multi-layered framework that includes four key components: validated data collection, compliant data storage and management, expert data analysis and reporting, and intelligent corrective action plans.

Each step of the framework is managed by a dedicated Program Manager that utilizes experts within the Sensitech Global Services Team network as needed.

The Sensitech Continuous Improvement Framework

1. Validated data collection
2. Compliant data storage and management
3. Expert analysis and reporting
4. Intelligent corrective actions

Using Data to Minimize Supply Chain Breaks

Most food retailers already collect supply chain temperature data to meet the basic requirements of food industry standard compliance or simple dock-level accept or reject decisions.

The data, however, can become a major asset when it comes to supply chain visibility, and the delivery of quality and safe food products. Companies can move beyond dock-level decisions and use actionable, relevant data to drive critical decisions throughout the supply chain that help them more rapidly meet and exceed critical key performance indicators (KPIs). For instance, in the food industry, process variation can wreak havoc, and data collection and analysis is the best way to identify that variation.

Meaningful and measurable insights derived from huge volumes of available data can be used in a broad array of metrics that help identify systemic weaknesses and variability in cold chain processes. And through extensive data analysis, specific problems can be discovered and isolated before they become even more costly.

For instance, data and expert analysis of this data can help:

- The improvement of processes related to temperature monitoring on individual shipments. Notifications can alert retailers when shipments are too warm or too cold so proper accept or reject decisions can be made at time of receipt.
- Moving beyond single shipment corrections, the identification of trends and patterns can help broader process improvement, as well as better resource allocation and improved quality and cost reduction. For example, data aggregated from hundreds or thousands of shipments can be used to identify temperature problems, necessitating further investigation into root causes, which help to ensure the continuous improvement of the cold chain and minimize the occurrence of future problems.

Sensitech is the only company that collects and aggregates cold chain data for purposes of evaluating processes in the food industry.

1. Validated Data Collection

The initial step in the Sensitech Continuous Improvement Program is the use of validated data logging instruments and data storage for in-transit, in-process and in-storage monitoring.

Sensitech Global Services streamlines the collection, management and analysis of temperature data through a variety of tools that make the process of continuous monitoring of shipments easy and efficient.

First off, we help customers define appropriate data acquisition or data logging goals and objectives utilizing a proven risk-based approach. For instance, our experts can help companies create a plan for what will be observed and measured, and align this with company KPIs to provide a baseline measurement that defines and measures progress against organizational goals.

We then manage the provision of data collecting and data logging monitors, as well as the appropriate programming of alarms and alerts across multiple temperature ranges and time thresholds. We also coordinate the program between the retailers, suppliers, shippers and distribution centers, providing the collaboration and training for the proper use and placement. Where appropriate, we can help adapt the program globally, adjusting as needed for local temperature requirements and languages.

2. Data Storage and Management

The data, once collected, is uploaded to the secure Sensitech ColdStream database, which is verified for the collection of an unbroken chain of clean and comprehensive data.

Based on the cloud-based ColdStream software, the Sensitech ColdStream database provides a secure and comprehensive data management system that our experts and customers use for viewing, storing, retrieving and analyzing of critical time-and-temperature data as well as detailed shipment and logistic information.

The Sensitech ColdStream database also complies with food industry audit requirements.

3. Analysis and Reporting

Throughout a Continuous Improvement Program, Sensitech Global Service experts leverage a wealth of industry experience and analytics expertise to evaluate the data and identify supply chain weaknesses. They use industry-standard and proprietary data analysis tools to identify variabilities in shipments that may lead to alarms or rejected shipments.

For instance, an enormous amount of raw data is collected on shipments and temperature. To extract the full value, we analyze and correlate data on a wide array of shipment attributes, such as suppliers, origin, destination, product, product type and transport company, with temperature data.

Using a statistical process control (SPC) methodology, we can help customers identify variations outside of allowable tolerances and regulatory requirements. As an example, using detailed time-stamped shipment information and temperature history, our team can examine individual shipment details and aggregated temperature data to identify systematic causes for variations or poor performance from a specific supplier or trade lane.

Through innovative metrics, we can provide insights on the compliance of programs and whether shippers and receivers are complying with SOPs. We can drill down into data on time-and-temperature monitors, shipping and receiving sites, unusual activities, data entry errors and user activities to find anomalies. This helps zero in on weaknesses in the supply chain and determine root causes.

The analysis can be used to measure against regulatory requirements and hold supply chain partners accountable and in compliance with established guidelines and contractual quality agreements.

4. Corrective Actions

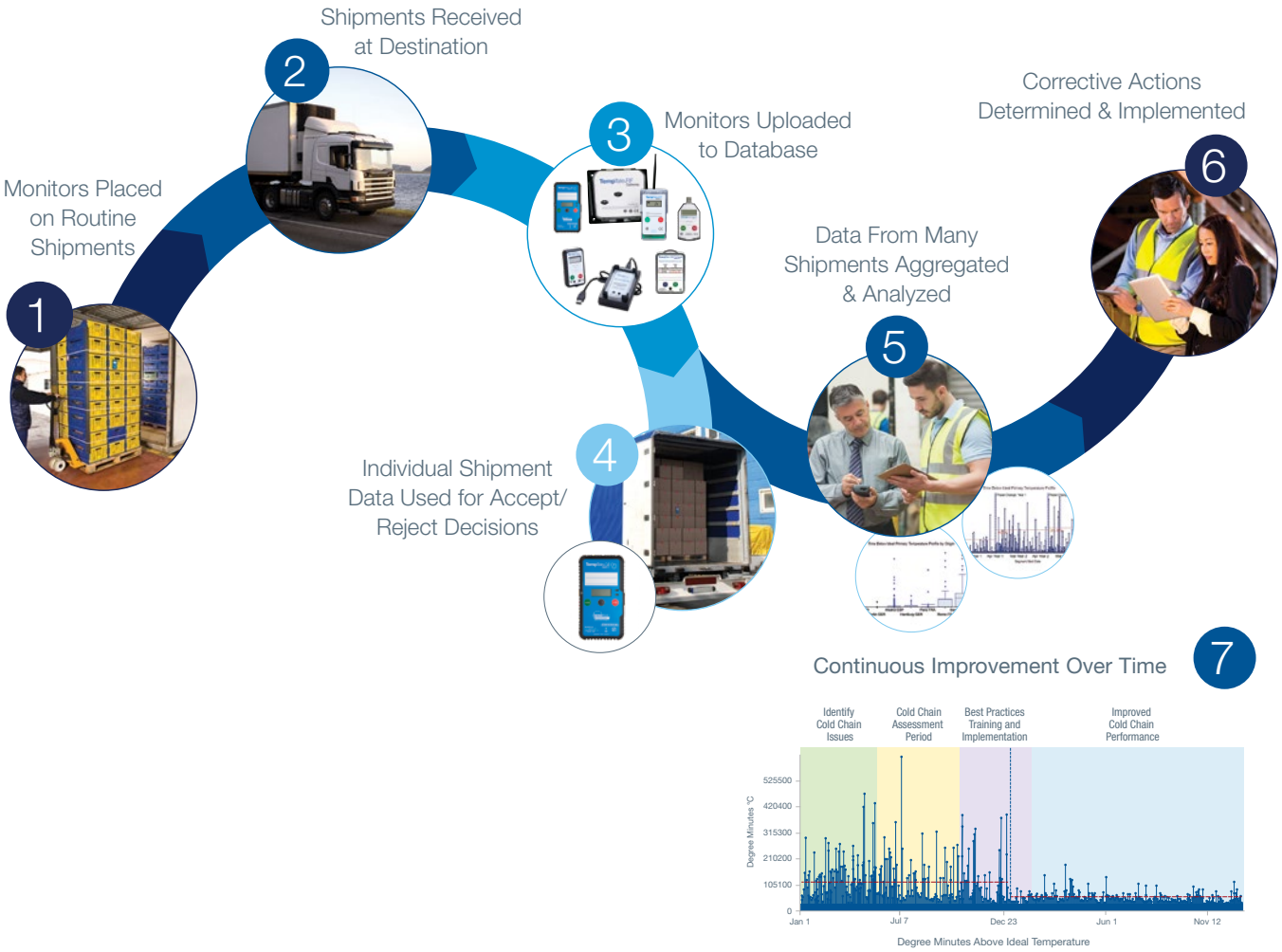
Once the data has been analyzed, the Global Services Team then delivers clear and concise reports with easy-to-interpret graphs and tables to customers to facilitate turning information into action plans that provide continuous improvement.

We offer services, such as onsite assessments, thermal mapping studies, and shipping studies, to help customers discover root causes to alarmed or rejected shipments. After the implementation of these discovery projects, we then provide recommendations for remedial measures for process improvement and corrective actions. We help customers prioritize the required changes and help ensure the corrective actions have a meaningful and measurable impact on the supply chain.

Our experts also work with customers to ensure that process changes maintain the desired outcome, ensuring continued alignment with the company's KPIs. The team also can facilitate communication to integrate the analysis and recommended changes across the supply chain between the food retailers and their shippers and distribution centers.

Using the identified trends and patterns as a base line, ongoing monitoring can then show if those process changes led to improvements.

The Intelligent Supply Chain in Action



The Impact of Continuous Improvement

When data and analysis is combined with Sensitech Global Services expertise and action by our customers, the results are significant—with considerable cost savings, process efficiencies and most importantly, improved food quality.

A continuous improvement program takes an ongoing and determined approach to identify root causes of issues and then remediate them. The use cases below provide a quick overview what can be achieved in a Sensitech Continuous Improvement Program.

CASE STUDY #1

Monitor over time to identify issues

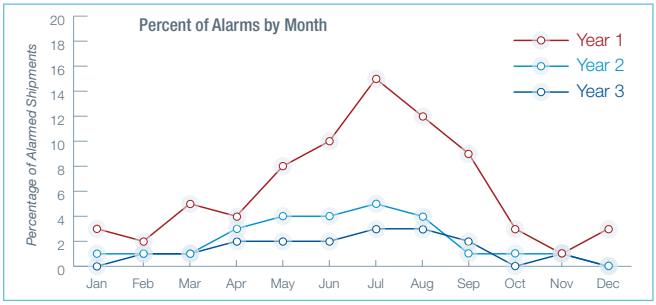


Figure 1: Reduced alarms over time

In a continuous improvement program, temperature-monitoring data can help identify issues that are contributing to poor product quality. For instance, a fresh poultry customer placed temperature-tracking monitors on shipments throughout Year 1, and identified that the number of alarms increased dramatically from February through October, with a significant peak in July. By discovering this previously unrecognized anomaly, the company put corrective measures in place and immediately saw an improvement. Within a year, the average number of alarms was reduced from seven percent to two percent.

CASE STUDY #2

Drill down to zero in on root causes

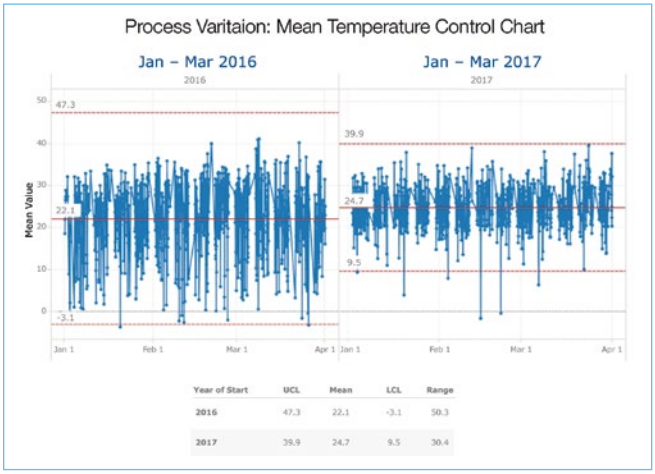


Figure 2: Identified outliers

To identify exactly where alarms occurred most for the higher temperatures in shipments, our Services Team uses data to produce temperature control charts. In the particular scenario in Figure 2, Sensitech helped the same fresh poultry customer identify where, when, and how many shipments were out of ideal temperature range. The customer then implemented the corrective actions proposed by Sensitech, which led to a 40 percent improvement in the consistency of shipments over the previous year for the same time period.

CASE STUDY #3

Take action for immediate results

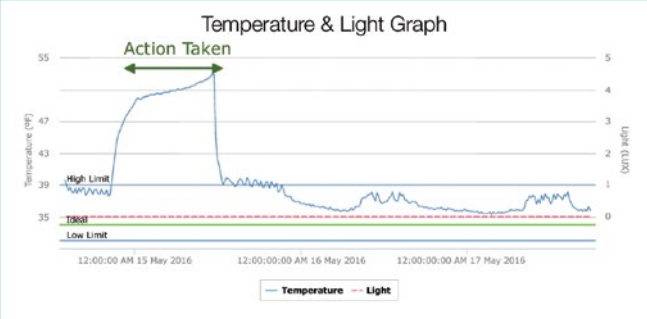


Figure 3: Immediate actions drive immediate results

Once problematic issues are identified, there is only one way to achieve improvement—and that is through taking corrective action. The good news is that most actions can have an immediate impact, as seen in Figure 3. In fact, the customer here used real-time notifications to alert the driver of this particular shipment that there was an issue. A blown hose was identified as the root cause of the dramatic temperature increase seen above. As soon as it was replaced, the shipment returned to the ideal temperature range, saving valuable product from spoilage.

CASE STUDY #4

Continue for improved results over time

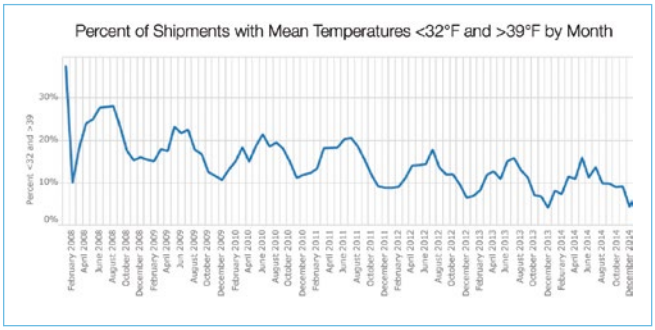


Figure 4: Action taken over time drives continuous improvement

Real continuous improvement does not happen overnight, especially as many of the elements of the supply chain can change in an instant and create new issues. To stay ahead in a continuous improvement program, quarterly data reviews with customers ensure the highest degree of improvement year over year, like this customer in Figure 4 has achieved.

Other Continuous Improvement Successes

- For a poultry customer, on-site assessments identified poor loading processes and damaged trailers. When corrective actions were taken, there was a 74 percent reduction in alarmed shipments and a 59 percent decrease in average degree minutes. Consequently, the customer now has more consistent shipments with reduced time spent on alarm resolutions and fewer quality complaints.
- A produce customer was experiencing excessive alarms at multiple locations. Onsite assessments of suppliers identified that there was insufficient product cooling and improper loading processes. After correcting these problems, there was a 45 percent decrease in average degree minutes, along with less variation between shipments, less time spent on alarm resolutions, and improved product quality.
- For a major food retailer that ships frozen French fries, there were excessive alarms on multiple shipments. Through several onsite assessments, along with thermal mappings, pallet cool down studies and supplier training, it was discovered that there were inconsistent temperatures within pallets and rail cars. Corrective actions led to a 36 percent decrease in average degree minutes. The shipments now have more consistent in-transit temperatures, so there is less time spent on alarm resolutions and fewer problematic shipments.

Conclusion

To ensure risk mitigation, it benefits food retailers and food service companies to invest in a continuous improvement program. Such a program extends the knowledge of their internal staffs with expertise that safeguards the investments these companies have made in protecting their products in the supply chain.

Improvements are readily apparent soon after a program is in place, with a rapid return on investment as well.

About Sensitech

Sensitech Inc. is focused on delivering supply chain visibility solutions that track, monitor and protect products for global leaders in the food, life sciences, consumer goods, and industrial markets. Our solutions are focused in three key areas: quality and compliance, supply chain security, and logistics performance management. Quality and compliance solutions address temperature-sensitive, complex supply chains focused on delivering the highest quality possible, while our supply chain security solutions help to mitigate risks associated with theft, diversion and chain of custody.

Sensitech's logistics performance solutions deliver origin-to-destination, real-time transparency to any in-transit journey. Sensitech Inc. is an ISO 9001:2015 company, headquartered in Beverly, Mass., with over 35 sales, service and distribution locations around the world. Sensitech is a Carrier company, a leading provider of heating, air conditioning and refrigeration systems, building controls and automation, and fire and security systems leading to safer, smarter, sustainable and high-performance buildings. Visit www.sensitech.com for additional information.

Sensitech Inc. • Global Headquarters • 800 Cummings Center • Suite 258X • Beverly, MA 01915-6197
1-800-843-8367 • +1-978-927-7033 • Fax: +1-978-921-2112 • sensitech.clientservices@carrier.com

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