

The Future of Cold Chain Logistics

AI's Role in Ensuring Safer TTS Shipments





Cold chain logistics are crucial for the transportation of time and temperature sensitive (TTS) products, such as pharmaceuticals and perishable food items. However, new risks are constantly emerging, and traditional cold chain solutions are quickly falling behind. Fortunately, artificial intelligence (AI) presents an opportunity for shippers to better protect their products, all while saving on costs, improving efficiency, and more generally enhancing supply chain operations.

In this white paper, we focus on the evolution of cold chain solutions and highlight how AI is set to revolutionize the sector. We also offer several predictions concerning where cold chain threats are headed next while offering suggestions for how to combat them.

We hope this white paper helps you better understand the unique risks faced by TTS products, what steps you can take to prevent them, and how companies like Overhaul, Zebra Technologies, and System Loco are leading the charge to preserve product integrity via AI-enhanced tracking and security features.

Unique TTS Risk Factors

Cold chain products are meant to be kept at very specific temperature thresholds. Even the slightest deviation can render a product unusable. While a huge hurdle, this is only the beginning when it comes to TTS risks. A slew of other factors can cost a company time, money, and even reputational damage.



Temperature Deviations/Excursions

TTS products across both the medical and food and beverage sectors are extremely sensitive to temperature deviations/excursions. For example, vaccines must stay within a defined temperature range or else risk losing their potency. Similarly, when exposed to inappropriate high temperatures, food and beverages often spoil. In both cases, the product is rendered, at best, ineffective or subpar, and at worst, potentially hazardous to consumers.



Logistical Complexities

Cold chain logistics require sophisticated coordination across different stakeholders. Communication or planning failures can result in suboptimal conditions for products, which in turn means lost goods. Additionally, TTS products require specialized equipment, such as refrigerated trucks (reefers) and real-time temperature monitoring systems. These items must be budgeted for, correctly used, and constantly maintained to preserve product quality.



Regulatory Compliance

Pharmaceuticals and food and beverages have strict regulatory compliance requirements. These requirements cover everything from how products are stored to who handles them and how records of their handling are maintained. Regulations can vary across different regions and products, which can be difficult for shippers to keep up with. Unfortunately, failure to meet compliance regulations can result in fines or even legal penalties.



Cargo Theft, Pilferage, and Tampering

Security threats such as tampering and pilferage are all too common for TTS products. Food and beverages are less likely to be targeted than high-value pharmaceuticals, but when stolen, the products usually cannot be sold, even after being recovered. Stolen pharmaceuticals cannot be sold by a company, and if criminals sell these products on the black market, a pharmaceutical company could be potentially liable for someone being harmed.



The Evolution of Cold Chain Solutions

Over the years, various solutions have been proposed to help cold chain shippers protect their products. Generally, these solutions can be broken into three eras:

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Cold Chain 1.0 – Passive Monitoring

Early cold chain systems relied on passive devices and manual processes, providing little visibility or control over shipments. Temperature excursions were only discovered after the fact—when it was already too late.

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Cold Chain 2.0 – Real-Time Alerts

The industry next advanced to real-time tracking, where shipments were monitored live, and alerts were sent when issues arose. However, this approach was still reactive and often led to increased costs as businesses scrambled to mitigate risks.

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Cold Chain 3.0 – Predictive Intelligence

Today, cold chain solution providers such as Overhaul are moving from reactive problem-solving to predictive risk mitigation. By analyzing historical data, weather conditions, and lane performance, we're able to make intelligent recommendations before issues occur.

In short, early solutions focused simply on tracking a shipment's location. Now, they anticipate disruptions and suggest alternative routes, packaging strategies, or intervention points. This enables shippers to save millions in potential losses, all while improving visibility, efficiency, and the ability to take decisive action.



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 System Loco.

The cold chain sector is at a critical inflection point. While basic visibility is now a minimum requirement, what's lacking is the ability to take meaningful action. Traditional RTTVP solutions have failed to live up to the promise of reducing spoilage through interventions—particularly in cold chain where losses have increased year-over-year.

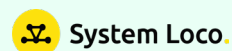
Souroush Honary
Co-CEO
System Loco



The Importance of AI

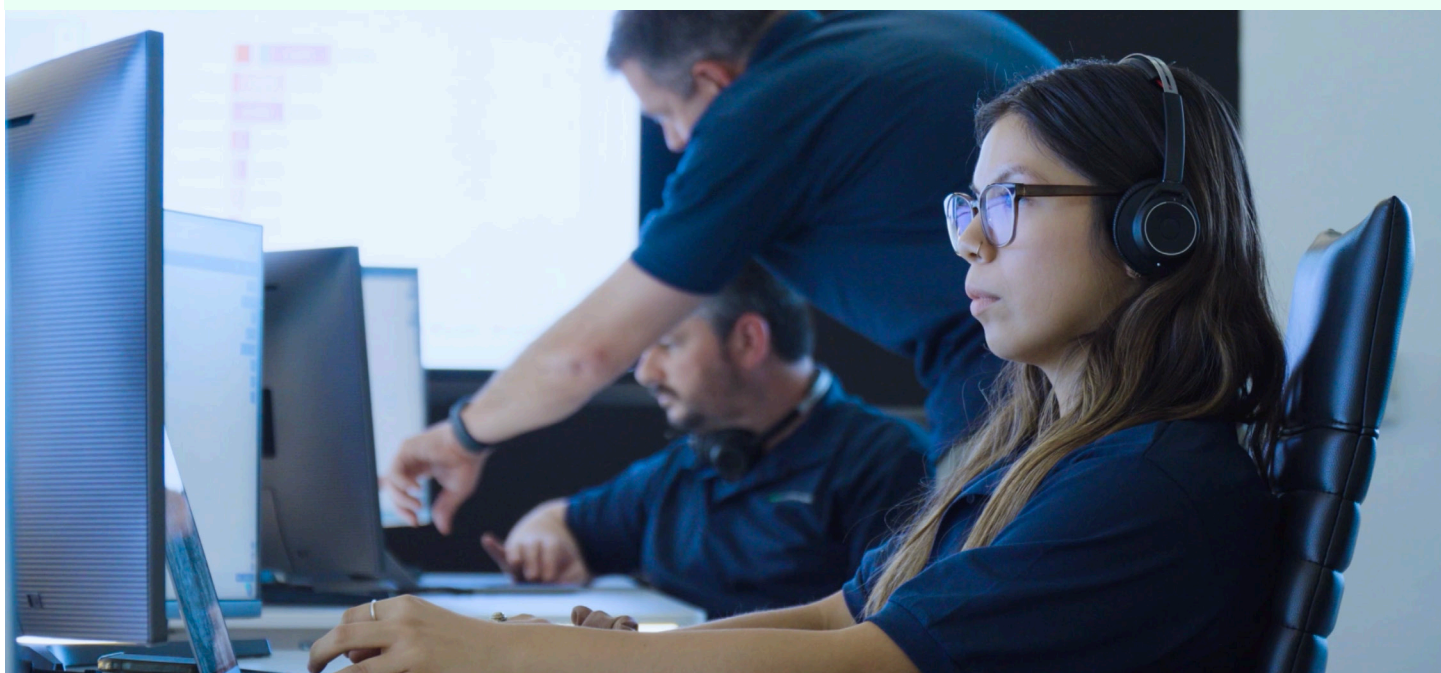
The future of cold chain isn't just about more sensors or better dashboards. It's about actionability and intelligence that empowers customers to make data-driven decisions before problems occur. More specifically, AI can be used to predict failures before they happen, automate intervention workflows that trigger contingency plans without human delay, and integrate external factors like weather, port congestion, and labor disruptions as actionable data. Plus, these self-learning systems continuously improve SOPs based on real-world events, which equals more useful and functional interventions.

Of course, AI on its own isn't enough to deliver an effective cold chain solution. Unpredictable issues can still emerge, underscoring the indispensable role of the human element. At Overhaul, our skilled team identifies, triages, and resolves risk events before they escalate into significant problems. Together with our partners Zebra and System Loco, we provide the foundational visibility and risk monitoring expertise that are critical to optimizing cold chain operations.



The key question is no longer 'Where is my shipment?' but 'What should I do next?' By saving shipments from excursions, we're enabling our clients to transform reactive crisis management into proactive supply chain optimization. The fundamental challenge remains data quality. Without reliable, real-time data, even the most sophisticated AI can't deliver value. That's why we're focusing on solving the data foundation first and then working closely with partners to bring intelligence that can be distributed between the cloud and the edge.

Orlando Candelaria
SVP Business Development
System Loco





Overhaul, Zebra, and System Loco: Making a Difference in Cold Chain Solutions

Overhaul has partnered with Zebra and System Loco to deliver holistic, customizable cold chain solutions to support TTS products. Combining our risk monitoring software with their IoT devices equals better visibility, greater control, and swifter responses. Additionally, our AI capabilities are enhancing predictive insights, thereby making it easier for TTS shippers to plan for what's ahead.

Simplifying Data Integration

The integration of Zebra and System Loco's technology with Overhaul's software platform allows for the seamless flow of data across systems. This integration supports comprehensive analytics and real-time decision-making, both of which are crucial for maintaining the integrity of sensitive shipments.

Improving Scalability and Adaptability

By working with these partners and their diverse technological offerings, Overhaul can scale solutions across different sizes and types of cold chain operations, from local distributions to global supply chains.

Delivering Comprehensive Support

Together with Zebra Technologies and System Loco, Overhaul can offer a more comprehensive solution that not only tracks and monitors but also anticipates and reacts to potential risks in real-time. This reduces the likelihood of product spoilage, compliance issues, and other risks.

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AI is transforming cold chain operations by enabling smarter decisions, faster actions, and reducing costs from manual processes and product waste. Teams can now digitize data and automate workflows, leading to better outcomes every day. Zebra proudly partners with Overhaul and System Loco, leveraging our extensive Environmental Sensor expertise to benefit food and pharma manufacturers, their distributors, and consumers.

Chris Caulfield
Vice President
Zebra Environmental Sensors





A Deep-Dive into Our Offerings

Zebra Technologies

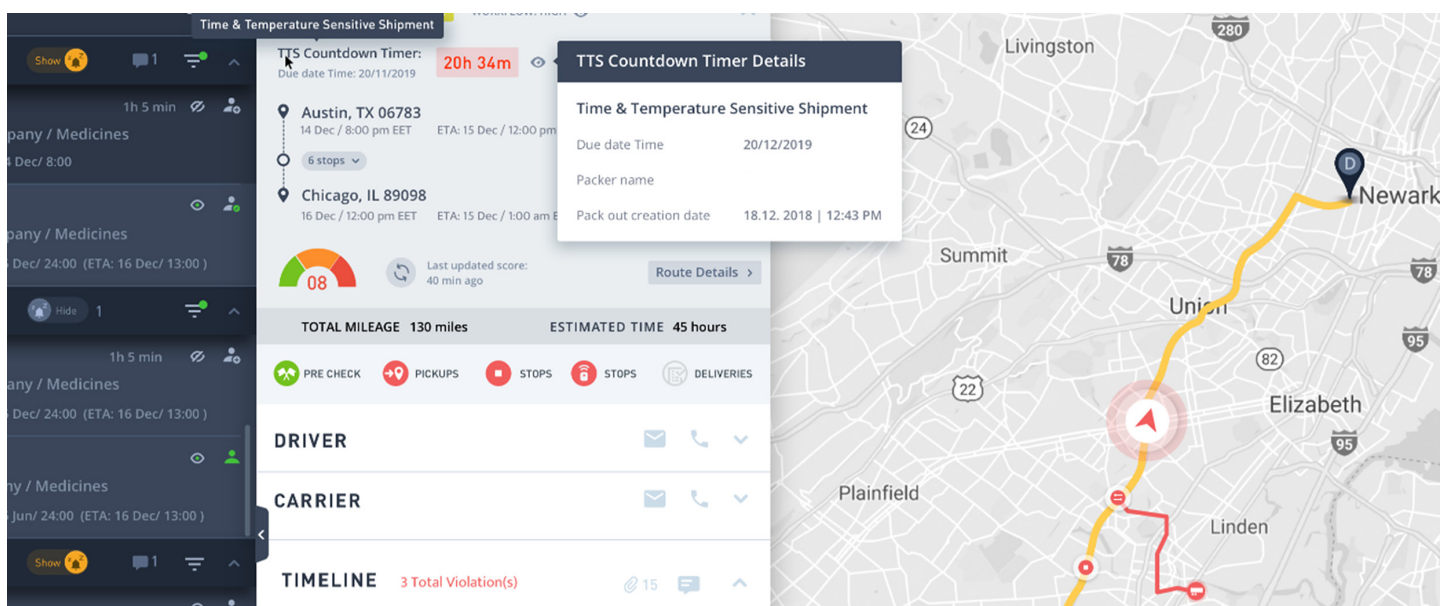
Zebra (NASDAQ: ZBRA) provides solutions to help businesses grow with increased asset visibility, connected frontline workers and intelligent automation. The company operates in more than 100 countries, and our customers include over 80% of the Fortune 500. Designed for the frontline, Zebra's award-winning portfolio includes hardware, software, and services, all backed by our 50+ year legacy and global partner ecosystem.

System Loco

System Loco is a global leader in edge-intelligent IoT technology solutions, powering real-time visibility across the entire supply chain—from production to last mile. Supporting high-stakes industries like pharmaceuticals, food and beverage, and high-value goods, our solutions integrate location, temperature, and shock sensing with advanced analytics. System Loco safeguards over 3 million shipments worldwide and equips supply chain teams with actionable insights they need to protect product integrity, ensure compliance, and reduce risk at every stage. Headquartered in the UK, we're redefining logistics intelligence through innovation, reliability, and scale. Learn more at www.systemloco.com.

Overhaul

Overhaul's platform combines visibility, intelligence, risk monitoring, and insurance to ensure comprehensive in-transit supply chain security solutions. Along with our TTS offerings, we provide real-time alerts to prevent theft, global insights to aid in route optimization, and law enforcement support to help recover stolen shipments. Our RiskGPT feature uses AI to improve threat response time while our FraudWatch offering enhances carrier vetting and verification. Additionally, we're data and device agnostic, which makes it easy to integrate with the technology that best fits your needs.





AI-Backed Answers to Emerging Threats

In the near-future, cold chain threats will continue to evolve and emerge, just as they have for decades. Already, delays and general confusion surrounding tariffs are creating issues for TTS shippers, and soon, we will likely see added complexities surrounding blockchain, sustainability initiatives, and the widespread use of autonomous vehicles, just to name a few things.

While no company can predict every cold chain risk to come, a good visibility and risk monitoring provider must be adaptable in all situations. Supported by our progressive partnerships, Overhaul, Zebra Technologies, and System Loco are well-equipped to take on the challenges ahead. By working with us, your company will also be ready for whatever is next, and with the help of our AI tools, anticipating and preparing for that next challenge becomes so much easier.



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As we look to the future, the complexities of cold chain logistics will only intensify. That's why Overhaul's AI-driven technology and strong partnerships are spearheading innovation. Given the critical time sensitivities of TTS products, now is the moment to invest in a solution that not only manages risks but anticipates them. Don't wait for a critical loss to act—prioritize prevention, and secure peace of mind.

Stefan Surpitski
Vice President, Sales
Overhaul