

Automation in Temperature-Controlled Environments

A Digital Transformation Journey Modernizing Commercial Refrigeration

A leading food retailer embarked on a transformative journey to modernize its commercial refrigeration operations. With a focus on optimizing perishables storage management, the initiative aimed to ensure food safety, improve quality, and integrate sustainability into daily operations. The company sought to build a smart ecosystem designed to minimize waste, optimize processes, and deliver the freshest products to customers.

This innovative solution **by Elpis**, though implemented in food retail, has vast potential for other industries reliant on temperature-controlled environments, such as pharmaceuticals, healthcare, logistics, and manufacturing.

Refrigeration That Works Smarter

At the core of the retailer's operations are several cold storage warehouses, each spanning 4,000 square feet. These facilities house a wide variety of perishable goods such as cold cuts, meat, seafood, dairy, fruits, and vegetables. Each product requires precise storage conditions, divided into specialized zones:

- **Chilled Foods:** Dairy and fresh produce maintained at 0°C to +5°C.
- **Meat and Seafood:** Stored at -2°C to -10°C.
- **Deep Freezer Goods:** Frozen items like ice cream preserved at -15°C to -18°C.

Maintaining proper storage conditions is critical, as the **temperature excursion rate** (percentage of time when storage temperatures deviate from the acceptable range) must remain near zero. Historically, temperature monitoring relied on manual checks, a process prone to delays, inaccuracies, and inefficiencies. Recognizing these limitations, the retailer partnered with **Elpis** to transition to a smarter, automated commercial refrigeration management system.

In the past...



Digital Transformation in Commercial Refrigeration : A Phased Approach

Phase 1 : Digitisation - use of IoT sensors for continuous measurement and centralised monitoring;



Phase 2 : Elpis E-REMOS for predictive maintenance; alerts operators based on algorithms output before issues occur



Phase 1: The First Step into Digital Transformation - From Analog to Digital

Elpis's phased solutioning focused on replacing outdated manual processes with leading-edge IoT and automation technologies.



This included:

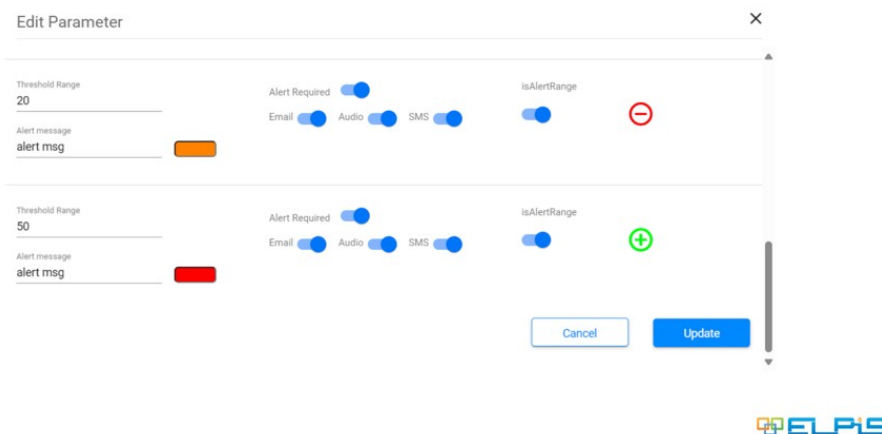
- **Real-Time Monitoring:** PT100 IoT sensors were installed across the storage zones to monitor ambient temperatures continuously and precisely.
- **Configurable Alerts:** Custom thresholds for each zone triggered real-time alerts via emails and messages, enabling

rapid responses to temperature deviations.

- **Centralized Management and Data visualisation:** 4G connectivity allowed warehouse data to be monitored remotely via the Elpis **E-REMOS platform**, providing a centralized view of all facilities.
- **Data-Driven Insights:** The **E-REMOS platform** visualized data for immediate insights, making temperature management both proactive and efficient.

The outcome? A refrigeration system that operated smarter, reducing risks of spoilage and ensuring consistent, high-quality storage conditions.

Image : Customisable alerts definition for temperature ranges in different zones



Reaping the Benefits of Smart Refrigeration

The results of this transformation were clear and impactful:

- **Enhanced Food Safety:** Custom alerts and continuous monitoring ensured that perishables consistently stayed within safe temperature ranges, reducing temperature excursion rates to near zero.
- **Operational Efficiency:** By automating temperature checks, employees were freed from routine tasks and reassigned to more strategic roles.
- **Scalability:** The solution is scalable if the company wants to implement this across its 1,000+ warehouses, with centralized control without sacrificing quality.

Phase 2 : Beyond mere monitoring : Smart Maintenance for Seamless Operations

Collecting real-time data is only the first step. Being able to analyse the data, identify patterns and use this information for business operational efficiency is the logical next step which is all about predictive maintenance. By analysing metrics such as **Response Time to Alerts (RTA)**, **Mean Time to Repair (MTTR)**, and **Mean Time Between Failures (MTBF)**, the company can:

- Identify patterns in equipment performance.
- Pinpoint refrigeration equipment (with geo-positioning data) that needs maintenance.
- Proactively address issues before they escalate into costly refrigeration failures.
- Extend the lifespan of refrigeration equipment through targeted maintenance.

This approach will not only prevent downtime but also safeguarded valuable inventory and reinforce the reliability of the company's cold chain operations. Additionally, it can provide information to fine-tune SOPs to reduce response times to critical alerts.

Key Metrics about product quality and integrity that would be monitored:

- **Temperature Excursion Rate:** Reduce to near zero.
- **Humidity Fluctuations :** Less than 5%
- **Spoilage Rate:** Less than 0.5%.
- **Shrinkage Loss :** Less than 1%
- **System Reliability:** Uptime of 99.9%.
- **Order Fulfilment Accuracy:** Exceed 99.5%.
- **Storage Utilization Rate:** Achieve over 85%.
- **Product Loss :** Reduce to near zero.
- **Inventory Turnover Rate:** Improve this month-on-month
- **Energy consumption :** Reduce this YoY

Expanding Applications: Solutions for Every Industry

While this smart refrigeration system was designed for food storage, its potential extends far beyond. Industries across the board rely on temperature-controlled environments, and this solution can revolutionize their operations:

- **Pharmaceuticals:** Ensure compliance with stringent storage standards for vaccines, biologics, and temperature-sensitive drugs while preventing spoilage.
- **Healthcare:** Protect critical assets like blood banks, organ storage, and medical supplies with real-time monitoring and predictive maintenance.
- **Logistics:** Optimize cold chain management with real-time temperature tracking during transit, ensuring goods arrive in pristine condition.
- **Agriculture:** Prolong the shelf life of fresh produce post-harvest while minimizing energy consumption for large-scale storage.
- **Manufacturing:** Streamline processes for temperature-sensitive production stages, such as those involving chemicals or food ingredients.

The adaptability and precision of the system make it a game-changer for any industry where temperature control is vital.

Phase 3: Automation and AI: The Last Frontier

Looking ahead, the company aims to integrate AI-driven systems to achieve an even higher level of automation and efficiency:

- **Dynamic Inventory Management:** AI tools will track inventory in real time, automatically adjusting refrigeration settings and prioritizing at-risk products.
- **Integrated Logistics:** Using [Elpis's m-Tracker](#), the company plans to optimize cold chain logistics, ensuring the highest quality even during transit.
- **Shelf-Life Optimization:** AI-powered analytics will dynamically adjust storage conditions to maximize the shelf life of products.
- **Customer-Centric Operations:** By guaranteeing fresher products with ample shelf life, the company reinforces customer trust and loyalty.

This vision of AI-powered refrigeration not only anticipates customer needs but also sets a new standard for sustainability and operational excellence.

Pioneering a Smarter Future

The company's transformation underscores the potential of IoT, automation, and AI to revolutionize temperature-controlled environments. By ensuring safety, enhancing efficiency, and enabling scalability, it has created a blueprint for success in industries that depend on precision refrigeration.

As the company continues to innovate, it is setting the stage for a future where profitability and sustainability work hand-in-hand—redefining what's possible in temperature-controlled storage across industries.