

Real-time, IoT-driven Supply Chains are Driving the Industry Forward

The opportunities that Internet of Things (IoT) technologies provide in leading digital transformations throughout the pharmaceutical supply chain aren't new. In the industry, IoT has transitioned from a passive technology to a mission-critical component that can provide continuous visibility and supply chain improvements.

IoT-driven temperature monitoring and visibility technology is making it easier to integrate key stakeholders from the first mile to the last, generate analytics into supply chain performance, ensure product integrity, and reduce costs and waste.

The pharmaceutical supply chain has become increasingly complex in recent years, while the industry has become more competitive. A growing number of drug therapies include active pharmaceutical ingredients that require low-temperature storage. Increased emphasis on improving patient outcomes, developing customer-centric models, reducing drug pricing, and expediting drug development has put the industry at odds with regulators and the patients it serves. Drug pricing pressures are driving focus on operational efficiency. In turn, manufacturers are turning to next-generation technologies to streamline processes and reduce waste, including new ways to handle, store, distribute, and administer their specialised, highly sensitive therapies to patients.

The costs incurred from temperature excursions are not limited to the direct costs of the ruined product and the costs associated with replacing it. Supply chain waste includes the operational costs incurred from the reporting, root cause analysis, and corrective and preventive action (CAPA) taken after a temperature excursion occurs. These operational costs have been reported to range from \$3000 to \$10,000 per investigation, at a per-incident average of approximately \$6500. For enterprises managing global supply chains, the costs

associated with both operational and product waste can add up to several million dollars annually.

Adapting the pharmaceutical supply chain to accommodate new, personalised medicines and therapies for efficient, cost-effective patient delivery will require change. Real-time IoT and cloud technology provide an opportunity to optimise supply chain and operational structure so as to eliminate or reduce steps and streamline timelines and costs. These cost-saving and efficiency gains are simultaneously enabling the industry to fulfill its social sustainability responsibilities.

Today's IoT-driven Supply Chain

For pharmaceutical manufacturers and other stakeholders, consolidating the supply chain "under one roof" brings a large range of benefits. Until recently, data has remained siloed among stakeholders, thereby inhibiting end-to-end temperature and location traceability drug products during transit and storage.

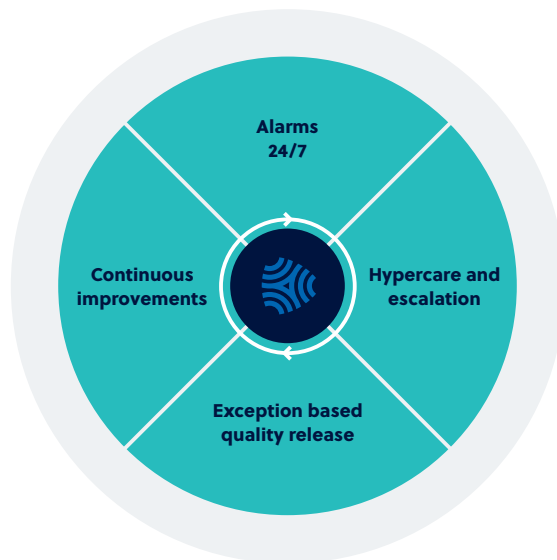
Data collected by IoT data loggers, while current while it is collected, was not always immediately available for review and analysis to assure the quality and safety of products at the end of the supply chain. A lack of visibility has

limited businesses to decision-making based on data at the end of a journey after degradation or waste has occurred. Today, IoT technology can remain with drug products as they travel throughout the supply chain, providing continuous transport, storage, and distribution data to supply chain stakeholders. Continuous product quality information is transmitted to a cloud software system and can be accessed by quality, logistics, and other stakeholders.

Real-time deviation alerts make it possible to proactively respond to temperature and other environmental issues in the supply chain as they arise to prevent product waste. The improved visibility and control are tangibly leading to a substantial reduction in risks and overhead, assurance of supply and compliance, tighter quality control, and even greater innovation.

The Differences in IoT Technology

While IoT temperature monitoring technology has been widely used throughout the industry for years, it is important to consider how the technologies can differ. Passive IoT loggers have been considered a lower-cost alternative for meeting the regulatory requirements, but they generally lack continuous connectivity to a cloud software system. Data is





available at the end of a shipment and must be manually retrieved from the IoT device, sent to a quality team to review the shipment data, and then accepted or rejected.

GPS trackers traditionally have been used for one-off volume shipments. This may not provide the flexibility needed for large, complex deployment. In addition, managing devices, as well as the costs of the quality review process, can prove cumbersome for enterprises with global operations.

IoT devices with sensors that rely on a local hub or gateway require the installation of a hub or gateway on the vehicle or at a site. This may not provide a viable solution for shippers and typically generally requires a substantial operational investment for installation. Real-time IoT technology automatically connects to the cloud and does not require the installation of gateways or hubs. Data loggers that are validated and compliant for use by air, road, rail, and sea, provide scalability and intermodal visibility through a single, integrated technology.

Becoming Smarter with Data

As pharmaceutical supply chains are increasingly digitised through IoT tracking, larger amounts of big data are being generated. Pharma 4.0 demands the gap between the digital and physical is closed, allowing for a 365-degree view of business operations. In a global supply chain, this can be difficult to achieve. Businesses often are still lacking a structured process to capture, evaluate, and act on the big data opportunities in their supply chains, held back by legacy IT systems, skillsets, and a lack of integration.

When end-to-end visibility is the goal, fragmentation is the enemy. It is not an overstatement to say data holds the key to creating efficient, compliant, and

demand-driven pharmaceutical supply chains, ultimately increasing profitability across the sector and improving health outcomes.

Big data generated from these technologies can also give pharmaceutical companies a more granular, real-time picture of events taking place along the supply chain, from manufacture to the last mile. By managing and recording real-time data centrally in the cloud, the opportunity for larger-scale reporting becomes possible through insights on supply chain performance and trends.

Through IoT and cloud-based technology, custom dashboard analytics can capture value-rich insights associated with shipments, including on the supply chain (origins, destination, routes, and sub-routes), on partners (freight companies, airlines, and packaging solutions), and external points of interest (cross-docks, harbours, airports, and borders). This is providing an unprecedented level of visibility for the industry.

Connecting the Dots

In addition to value-rich insights, real-time

IoT technology can facilitate supply chain automation in a number of ways.

- **Control tower visibility:** A combination of continuous distribution and storage data that is viewable centrally through a software platform and 24/7 monitoring and response services can provide protection and control over shipments, as well as the ability to intervene if temperatures start to deviate beyond designated boundaries.
- **Shipment escalation:** In addition to temperature and product quality information, real-time IoT technology can be used to identify odd shipments requiring review based on custom business rules. For example, there may be a mandatory truck driver stop of eight hours. If a stop extends to 12 hours, the shipment may be flagged for attention. If a shipment has travelled through an unexpected route or harbour, this may similarly trigger a required review.
- **Automated releases:** Real-time IoT-driven supply chain visibility provides for an exception-based quality review process. Quality



managers gain access to product quality conditions while shipments are en route and can take alternate measures needed if an issue arises during transport. The availability of on-demand data enables a faster review and quality release process. Problem shipments are automatically segmented for review, reducing the operational resources needed for investigations.

- **Environmental sustainability:** Manufacturers are setting lofty sustainability objectives to reduce their carbon footprint. Some are aspiring to be carbon neutral or carbon negative within the next 10–20 years. Moving ahead, reducing waste in the supply chain will be a primary focus. The shift to reusable packaging and IoT data logger technology will provide measurable and substantial consumption savings, in addition to product waste savings.

Value at Each Step of the Supply Chain

Visibility generated through real-time IoT monitoring supports stakeholders throughout the supply chain.

- **Pharmaceutical manufacturers** are able to achieve end-to-end traceability of their products from manufacture through transport, storage, distribution, and last-mile delivery. Working with suppliers and logistics providers, they are able to take ownership of their supply chain data, gaining valuable analytics and insights into what is working and what requires attention. Data can be shared with their supply chain stakeholders to facilitate

risk mitigation and continuous improvement throughout.

As an example, products travelling by air freight transporting a launch product were split up at Dublin airport. Products left behind weren't kept in an adequately controlled environment. Real-time IoT technology identified both issues. The pharmaceutical manufacturer's logistics provider facilitated intervention saving millions of dollars worth of product and preventing a downstream stock outage.

- **Freight forwarders, 3PL/4PLs, and distributors and wholesalers** can provide a differentiated, value-add service to their clients through real-time IoT-driven visibility. Supply chain data can be integrated into their client-facing system to provide shipment visibility. By managing real-time temperature alerts on behalf of their clients, they are able to facilitate corrective response to prevent product wastage from occurring.
- **Packaging providers** can utilise real-time monitoring to provide a competitive, value-add service to track the location and environmental conditions of products used with their technology. Through the use of real-time IoT technology, lane and packaging validation studies can be concluded more efficiently, with data automatically made available during and at the end of each shipment.

The Future of IoT-driven Data

Through the evolution of real-time IoT traceability data and cloud capabilities in delivering real-time and predictive and

prescriptive analytics, the opportunities for stakeholder collaboration throughout the pharmaceutical supply chain and industry are substantial. Moving ahead, industry participants can contribute their anonymised supply chain data into a data ocean.

This would allow enterprises to compare their supply chain performance with industry performance at large while providing value-rich data for the global supply chain. Industry-level benchmarking data and data sharing enables businesses to improve their supply chains and help the industry strengthen the supply chain as a whole.

Conclusion

While complete eradication of temperature excursions within the pharmaceutical supply chain is unlikely, real-time, IoT-driven visibility is providing measurable benefits for waste reduction, sustainability savings, and operational improvements leading to substantial cost savings. Through data, trends begin to surface, strategic decisions can be based on facts and data, and risks can be identified and mitigated, and annualised product and operations cost savings can be achieved. Moving ahead, this technology will strengthen the industry as a whole.



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