Elevating the Cold Chain Experience Digitally

Introduction

As supply chain risks intensify with the rise of cell & gene therapies and other complex medicines, innovations such as virtual modeling with digital technologies present new opportunities to optimize shipments of these delicate biological therapies.

Simulation technology and real time data tracking hold the promise of fresh new insights, from shipping lane analysis of historical weather patterns to credible sustainability impact estimates that are useful in comparing different packaging options. Yet successful digital modeling technology and predictive analytics depend on data collaboration among ecosystem players – including logistics providers, pharma companies, and packaging providers – to truly optimize how each life science shipment should be made.

This brief white paper will examine the forces driving digital modeling ecosystems, surface examples of digital modeling successes from other industries, and discuss the pain points in the current pharmaceutical shipping cold chain that digital modeling technology could potentially alleviate.

Three key drivers of digital ecosystems

You are likely to have seen more and more references to digital modeling technology. On its surface the idea is relatively simple. As the name suggests, these are virtual models of physical objects or groups of objects in a network. Because digital objects are easier to manipulate, digital modeling technology can be used for testing, simulation, monitoring, maintenance, and many other practical tasks.

A confluence of factors can be attributed to the rise of interest in digital technology across industries.

1. Ubiquitous sensors

Sensor-generating signals are now everywhere thanks to edge connectivity, digitization, and IoT technologies. Whether it is the use of traffic sensors streamlining the flow of vehicles or machines "talking" in factories, sensors are capturing and emitting data streams to measure position, pressure, temperature, force, vibration, humidity, piezoelectric charge, and fluid properties.

Implications for digital modeling: Sensors enable the capture of richly detailed time series of real-world data that enable modeling far more realistic than the limited data currently used in computer-aided design (CAD).

2. The continued rise of the cloud

The public, private, and hybrid cloud acts as a powerful unifier, drawing sensor-based signals from any corner of the earth and breaking down silos in enterprise supply chains and the disparate systems they rely on. These include warehouse management systems, transportation management systems, product lifecycle management systems, manufacturing execution systems, and CRM systems. The cloud is a driving force for integration because it allows you to build digital layers of this information on a common foundation.

Implications for digital modeling: The cloud offers infinite scalability, which allows digital models to expand and handle increasing amounts of data without having to invest in additional infrastructure. The cloud also allows greater access from anywhere as well as better real time monitoring and analysis, both crucial capabilities as more computing moves to the edge of networks.

3. Big data technologies

The data ingestion and ultrafast processing technologies required to generate insight from the flood of new digital signals are now widely available. Taken together, these technologies are able to clear away the supply chain fragmentation that has built up over the past four decades.

Implications for digital modeling: Big data technologies are driving higher accuracy based on ingestion of more data, better predictive capabilities based on pattern and trend identification, and system-wide savings based on the ability to simulate and test different scenarios.

Digital modeling technology advancing other industries

Several industries have driven the evolution of digital modeling technology over the past 30 years, starting with computer-aided design (CAD) and computer-aided manufacturing (CAM) software. With the greater – and cheaper – availability of IoT sensors, the cloud, and big data technologies, the barriers to digital modeling, simulation, and integration are rapidly falling. This is especially true when it comes to time-series modeling and simulation. It is this area especially – system-level simulation to predict possible outcomes – that digital modeling technology can deliver significant benefits over current models.

In Aviation,
for example, digital modeling technology allows you to make future predictions of airplane performance by simulating upcoming events such as weather or wear and tear on a digital application of the plane engine and wings.

In Renewable Energy,
a wind farm can create a digital replica to determine how wind angles and speed impact its turbine wings. They also can project forward from historical data on energy generation to predict how much energy the farm is likely to generate in the next quarter or the next year.

In Water Management,
companies have introduced digital modeling solutions to help budget-strapped utilities and treatment plants model complex processes to look for efficiencies. Powered by artificial neural networks, these digital models have enabled utilities across the world to reduce energy consumption by 10 to 30 percent and slash the amount of nitrogen and phosphorous they use each day.

Accelerating the pharmaceutical cold chain with digital modeling technology

Digital technology holds great promise to revolutionize the pharmaceutical cold chain, offering exciting possibilities to streamline processes, enhance shipment visibility and enable proactive decision-making. Here's how digital modeling can transform the cold chain:

Optimizing Complex Logistics

Digital capabilities enable virtual modeling of production lines, shipping lanes, and container availability, facilitating precise and adaptive planning for efficiently moving drugs from manufacturers to patients, reducing potential delays, and ensuring smooth and more accurate planning.

Enhancing Network Awareness

By integrating data across all players in the pharmaceutical cold chain, digital modeling eliminates inconsistencies and inefficiencies. With access to updated SOPs, shipping lane insights, and container availability, every stakeholder operates with precise information.

Leveraging Historical Trends

Digital modeling technology makes it easier to analyze historical data, helping identify optimal sites for container stationing and improving turnaround times. This proactive approach ensures containers are always in the right place at the right time.

Real time Shipment Monitoring

With real time shipment monitoring and predictive AI capabilities, digital modeling technology empowers stakeholders to anticipate and address potential excursions before they happen, ensuring payloads remain protected throughout the entire shipment.

Driving Proactive Collaboration

Its ability to provide accurate data sets digital modeling technology apart, allowing stakeholders to make informed decisions. At the same time, the integration of predictive analytics identifies optimal routes and shipping lanes based on historical patterns, enhancing efficiency across the board and ensuring that life-saving pharmaceuticals reach patients when and where they need them.

Connecting to the virtuous cycle

For logistic service providers, digital modeling technologies can predict the results of booking or not booking in a particular port or air traffic lane given historical patterns. Today these choices are loosely based on experience and small pools of data. There is no truly systematic basis for decisions. This is where much of this intelligence will be deployed.

In practice, a virtuous cycle of improvements and benefits are made possible when real-world performance data across all ecosystem players feeds virtual cold chain models. These benefits will include:

1. Higher operating efficiencies
2. Greater container reuse
3. Better patient outcomes
4. Better quality and compliance
5. Higher accuracy based on optimizing containers for product and shipping lane use case

Based on these benefits, joining the "silent revolution" of digital modeling will become increasingly key to staying competitive, no matter what part of the ecosystem you occupy.

As technology evolves and as pharmaceutical managers pose questions they cannot address easily with current solutions, architectural models are quickly rising to answer them. For these reasons and many others, digital modeling technologies have rightly been described as "an unstoppable market transition." It is a transition that all players in the pharmaceutical cold chain would be well advised to undertake.

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