

# Modernizing the Supply Chain in Healthcare and Life Sciences with Data + AI

Slalom | Databricks



# The Healthcare Supply Chain: A Case for Change

# Perhaps more so than other industries, COVID-19 upended the historical dynamics of supply & demand in healthcare.

We have witnessed unmanageable spikes in ICU bed demand, nursing shortages, and massive gaps in COVID-19 diagnostic tests (due to both the tests themselves, as well as testing capacity). At the same time, the Life Sciences industry has grappled with the challenges of an inadequate cold chain that is ill-equipped for mass vaccine distribution, not to mention unprecedented spikes in demand for products like Tylenol.

Many organizations have struggled to do real-time reporting on data from ERP systems like SAP and Oracle, creating gaps in inventory moving through distribution centers. These gaps can result in unfulfilled orders, financial penalties, lost revenue, and critical shortages ranging from medications and vaccines to medical devices at hospitals and empty shelves in retail stores.

**Driven in part by these new levels of urgency, organizations have begun to make the required investments in modernization.**



# Building an Intelligent Supply Chain on the Lakehouse

# In any supply chain, products move through various processes that have both upstream and downstream impacts when not executed properly.

Simplistically, product is inbounded from a manufacturer to a distribution center, where it is moved into inventory, before being out-bounded to the customer. For example, if a product is not received at the distribution center, it is not available in inventory, and the company cannot fulfill an order to a customer.

As a product moves through the supply chain, there are various pieces of data captured so it can be tracked and accounted for, and often that data is siloed, is difficult to access, and/or cannot be aggregated with all the other products moving through the supply chain. While there is an emphasis within organizations to better understand the supply chain and identify opportunities for improved efficiency and cost-saving opportunities, running ad-hoc or scheduled queries against legacy source systems does not allow for teams to glean insights quickly or easily, limiting their agility.

Organizations are elevating their supply chain departments to become more data-driven with the introduction of the data lakehouse architecture and machine learning. While there are countless tools that enable businesses to create a data-centric environment, they are typically fragmented.

**The lakehouse provides a unified platform for all data, analytics, and AI, making it easier to deliver the right information in real time to those who need it the most.**



# A Fortune 100 Life Sciences Company

adopts the Lakehouse as an accelerator for modernizing supply chain analytics.



# No one understands the dynamics of a complex supply chain more than large enterprises with supply chains spanning multiple sectors.

Slalom worked with one customer that distributed thousands of everyday consumer products to over 100 countries globally, helping communities around the world lead healthier lives. Ensuring the right products reached those in need in a timely fashion required a robust data and analytics system capable of providing insights from the production line through delivery on store shelves.

When it came time to modernize their analytics stack, the supply chain analytics team enlisted the help of Slalom, seeking to partner with a global leader in strategy and technology consulting. Together, we adopted Microsoft Azure and the Databricks Lakehouse for Healthcare and Life Sciences as the foundation to modernize their technology infrastructure, resulting in both automated shipment tracking processes, as well as more accurate forecasting.

## Use Case #1: Automated Shipment Tracking

Our customer's performance team relies on On-Time, In-Full (OTIF), and Proof of Delivery metrics as a key piece of their supply chain performance analytics for their products; however, their primary shipping carrier only allowed automated data access through a complex API, providing heavily nested XML with an unpredictable schema. As a result, our customer was manually tracking shipments to feed into OTIF and relying on a third party to deliver Proof of Delivery over a month later, costing them valuable time to resolve shipment issues or improve supply chain performance during shipment.

Our solution was to build a data pipeline using python on Databricks, which interacts with the carrier's API, crawls through the XML structure, normalizes it into a flat and predictable schema, and outputs the data into a table that could be pulled into several key dashboards for stakeholder use. It is critical that this data is reliably updated throughout the day as shipments are delivered.

Due to the complex nesting and often unpredictable XML structure (tags change, important data elements shift in the tree, API responses sometimes contain malformed XML), we built a number of components in our pipeline that can handle and log exceptions, flatten the data to a reliable structure, and interact with supporting services such as data visualization tools. A key requirement of our solution is the ability to have each component structured so it can be developed independently (sometimes in different notebooks) and yet interact seamlessly from the main entry point to the pipeline.

Databricks natively supports python and allows us to easily install a multitude of key libraries that are needed in our solution. Databricks notebooks integrate with CICD pipelines and allow us to import core code in our pipelines and import any custom libraries or classes as a part of our solution. The pipeline runs on Azure Databricks which is scheduled through Azure Data Factory and outputs the data to Azure Synapse. Databricks acts as the perfect middle step to get the data and manipulate it in a reliable and quick fashion.

**To the next Use Case >>>**



## Use Case #2: Improved Forecasting with Machine Learning

Following shipment tracking automation, we shifted our focus to improving forecasting with the data science functionality of Databricks. This is critical because if a forecasted amount is outside of 20% variance, there are fines based on contracts representing millions of dollars of potential risk. The prior forecasting method involved significant manual effort that slowed the process considerably, missing shifting patterns and behavior due to the pandemic.

Our solution was to build a statistical time series model that incorporated the actual, erratic behavior. Databricks suite of ML tools and native support for R helped in developing and evaluating the time series models. The exponential smoothing model (ETS) was chosen among others (Arima, TBATS), as it performed the best in time series cross-validation. The model successfully weighted recent erratic behavior: the ETS model prioritized the most recent data points and had the rest exponentially decay in importance (hence exponential smoothing) while also capturing seasonality and trend.

The model runs on Azure Databricks as a weekly job leveraging the in-built CRON scheduling feature that publishes the output of the job to the Azure Synapse using the Databricks Synapse connector. Publishing the process through Databricks reduced the manual work while harnessing the power of the Databricks cluster, which enables one-click scaling.

# Getting Started

Supply chain organizations are modernizing their data and analytics capabilities to minimize the risk of lost sales, reduce carrying costs, and improve customer satisfaction. To help ensure your modernization effort is effective and produces your desired outcomes, it is important to start with identifying success measures and building an analytics roadmap that can directly improve that measure.

Once the key performance measure(s) have been identified, Slalom 'works backward' in partnership with our customers to define the user journey, data visualization design, requisite data, and AI, as well as operationalizing the end-to-end pipeline. Supply chain organizations are adopting a dedicated environment known as a Control Tower. This is a single source of data for your business that reduces manual data wrangling and analysis by bringing ingestion, governance, analysis, predictive modeling, visualization, and business insights all into one platform.

**Impactful & Actionable Metrics >>>**

# Our customers focus on **impactful** and **actionable metrics** at the strategic and execution levels

## Strategic

- Customer Fill Rate/On-Time delivery/Perfect Order Percentage
- Manufacturing Cost as a Percentage of Revenue
- Productivity in Revenue per Employee
- Rate of New Product Introduction
- Unconstrained Demand vs Supply
- Dependent Demand

## Manufacturing

- Raw Materials Usage
- Production Volume
- Yield
- Cycle Time
- Customer Rejects
- Throughput/Utilization
- Health/Safety
- Planned vs Emergency Maintenance
- Total Cost per Unit
- Energy Cost per Unit

## Inbound

- Dock to Stock
- Perfect Receipt
  - Accuracy
  - Condition
  - Documentation
  - Efficiency
- Yard Trailer Management
- Cost to Receive

## Inventory

- Inventory Turnover
- At Risk Inventory
- Expired Inventory
- Slow Moving and Obsolete Inventory (SLOB)
- Safety Stock
- Inventory Accuracy
- Inventory Capacity
- Blocked Stock
- In Transit
- Delayed Production
- Excess Inventory

## Outbound

- On Time Ship (OTS)
- On Time In Full (OTIF)
- Shipment Methods, expedites and associated costs
- Average time spent on picking and shipping inventory
- Freight Cost
- Freight Origin Cost
- Fuel costs
- Lane costs

## Receiving

- Dock Door Utilization
- Receiving Cycle Time
- Put Away
  - Cost per
  - Accuracy per
  - Cycle Time
- Inventory to Sales Ratio
- Average Order Size
- Rate of Returns



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Who We Are



# About Slalom

**Slalom is a purpose-led, global business and technology consulting company.**

Slalom is a purpose-led, global business and technology consulting company. Our purpose—to help people and organizations dream bigger, move faster, and build better tomorrows for all—guides everything we do. And our north star is our vision of a world in which each person has the opportunity to love their life and work.

Since our consulting business started in 2001, Slalom has grown rapidly to 13,000+ team members in six countries and 43 markets. From strategy to implementation, our approach is fiercely human. We deeply understand our customers—and their customers—to deliver practical, end-to-end solutions that drive meaningful impact. We also nurture strong partnerships with over 400 leading technology providers, including Databricks.

We're honored to be consistently recognized as a great place to work, including being one of Fortune's 100 Best Companies to Work For seven years running. **Learn more at [slalom.com](https://slalom.com).**

## What makes Slalom different?

We take love seriously. So seriously that we measure customer love in ten dimensions and use those metrics to guide our actions.

Head and heart in everything we do. We show up authentically and get to know you, always leading with empathy and kindness.

Local soul, global scale. Because we live where we work, we're committed to our local communities and your long-term success—while also staying connected globally.

Momentum that outlasts us. We work with our customers' teams every step of the way, teaching and empowering them to continue the momentum even after we leave.

Deep connections, better outcomes. Our thorough understanding of partner technologies and priorities drives trusting relationships and exponential impact.

# About Databricks

**The AI & Data Company helping data teams solve the world's toughest problems.**

Founded in 2013 by the original creators of Apache Spark™, Databricks has created a culture of engineering that attracts the best talent in the world. This engine of innovation has produced Delta Lake, MLflow, Koalas and is pioneering the convergence of data and analytics so data teams can innovate faster.

True to our origins in academia and the open-source community, we're all about sharing knowledge, debating concepts and constantly refining our thinking in the pursuit of truth. More than anything, we believe in the meritocracy of ideas – the best ideas, backed by data and results, will always rise to the top.

To learn more, follow Databricks on [Twitter](#), [LinkedIn](#) and [Facebook](#).





# Ready to take the first step?