GAINS
MOVE FORWARD FASTER

Whitepaper

Manage Uncertainty with GAINS Lead Time Predictor Service

Executive Summary

Lead time prediction is a crucial aspect of supply chain management, and traditional methods often fall short in accurately forecasting lead times due to their assumption of stability. It can improve supply chain performance by promoting functional excellence in supply chain planning while enabling better collaboration with suppliers and customers to manage uncertainty and boost resiliency in the face of potential disruptions. However, using machine learning (ML) models, such as those employed by the GAINS Lead Time Prediction service, offers more accurate predictions by considering multiple factors simultaneously and understanding supply chain complexity. Companies stand to benefit from reduced supply chain costs, improved customer service, and risk avoidance by implementing lead time prediction.

The adverse effect of lead time uncertainty on supply chains is universally understood as a critical challenge. In addition to effects on service and cost, lead time impact on sustainability, notably carbon emissions, has gained prominence in the supply chain community.[1]

Companies stand to benefit from reduced supply chain costs, improved customer service, and risk avoidance by implementing lead time prediction.

Though highlighted during COVID, lead time uncertainty has always existed: it mattered less when orders were large, inventory was cheap, and single-sourcing was common. In recent years, uncertainty has become greater and more impactful. Beyond that, diversifying supply chains to build resilience subtly creates complexity and ambiguity in the data used for classic lead-time calculations. Imagine a hypothetical manufacturer that used to order a crucial spare part from a single supplier every six months. The legacy vendor's lead times have become more volatile, which makes calculating lead time harder. The manufacturer decides to pursue a multi-sourcing strategy involving three new suppliers to achieve greater supply chain resilience. That sounds great, except now the manufacturer's observed lead-time data contain orders from four vendors, each characterized by idiosyncratic constraints. Where the manufacturer previously observed four supply orders from one vendor over two years, they might now observe four orders from four distinctly different vendors over the same horizon. Classic lead-time calculation methods will struggle across heterogeneous data, whereas GAINS's lateral machine learning service manages this natively.

1 (Li, et al. 2021. "The Impact of Lead Time Uncertainty on Supply Chain Performance Considering Carbon Cost." Sustainability. https://www.mdpi.com/2071-1050/11/22/6457)

An Understanding of Lead Time Prediction and Its Impact

Within Supply Chain Planning, lead time is used in Inventory Management, Production Scheduling, Order Fulfillment, and Supplier Management. It is a critical factor in decisions that determine optimal inventory levels, when to place orders and how much to order, stocking policy, available-to-premise calculations, supplier performance, and supplier selection.

Lead time values are frequently maintained in an ERP or other transactional system of record. Typically, there is some automated lead time calculation used but it is simplistic and based strictly on past order receipts with no forward-looking view. The result is an incorrect value used to represent lead time.

The primary impacts of lead time inaccuracy on supply chain planning and execution fall into two categories: customer order fill rate and inventory. When lead times are understated, on-time in full (OTIF) and available to promise (ATP) are affected, leading to dissatisfied customers, loss of revenue, and increases in expediting costs. When lead times are overstated, inventory surplus is often the result, which increases costs, reduces cash flow, increases the risk of obsolescence and spoilage, and reduces the return on assets.

The GAINS Lead Time Prediction service is a material/order-level forecasting method used to estimate the amount of time it takes to fulfill an order. The lead time prediction supersedes the ERP or transactional system of record lead time value when creating models to automate tasks like purchase order creation, approval, and delivery date notification.

The Benefits of Better Lead Time Prediction



Revenue growth

Accurate lead time prediction significantly influences the quality and efficiency of demand, replenishment, and production planning processes. Lead times are essential for business profit since a slight improvement can significantly impact revenues.



Supply chain cost reduction

Lead time prediction is a critical factor for determining the optimal inventory levels for companies. It ensures that they have the needed on-hand amount to help them meet customer demand while minimizing excess inventory. As a result, it allows for saving additional costs, in particular carrying costs and costs associated with expedited shipping.



Growth target attainment

Lead time prediction supports growth by achieving target fill rates, enhancing customer satisfaction, and improving inventory management. It allows businesses to efficiently handle higher volumes of inventory and transactions without sacrificing accuracy or customer fill-rate performance.

Customer service improvements

An effective lead time prediction process helps companies provide reliable delivery dates to their customers, which improves customer service and satisfaction.

Risk avoidance

Lead time prediction allows companies to identify and manage potential risks associated with supplier delays.

Improved worker productivity

Eliminating the manual effort of managing supplier lead times, decreasing expediting activity, supporting supply sourcing decisions, and decreasing disruption to production schedules all result from improved lead time prediction and have a direct impact on labor efficiency.

Environments That Benefit Most from Lead Time Prediction Improvements

Better lead time prediction is helpful in almost any organization, especially for companies with many suppliers to manage. For example, most of GAINS' customers will have less than 300 suppliers that supply most of their material requirements, but the total number of suppliers is in the thousands. They have a long tail of niche suppliers that are ordered from less frequently. These niche suppliers have fewer observations for a traditional lead time calculation, making prediction hard. Furthermore, these smaller vendors can be more prone to supply chain disruptions, making them less reliable.

Another environment where lead time prediction can deliver significant improvement is at companies that have large volumes of orders placed with overseas suppliers. Oversees suppliers rely on intermodal transportation and multiple carriers to deliver products, which increases the likelihood of disruptions in supply.

More accurate prediction capability coupled with data analytics to identify trends & correlations and support decision-making provides a basis for proactive risk mitigation and collaboration across trading partners.

Value Chain Performance Improvements

Promote functional excellence

The primary use of lead time prediction is to utilize the predicted lead time in inventory management and replenishment planning. It is an input into many supply chain decisions, including:

- Optimal Stocking Policy throughout the network
- Optimal Service Stock quantity
- Replenishment timing and quantity
- Near-term supply sourcing decisions (primary vs. alternate)
- Available-to-Promise (ATP)

Enable value chain orchestration

Lead time prediction helps companies achieve a higher degree of integration and collaboration with their suppliers and customers. More accurate prediction capability coupled with data analytics to identify trends & correlations and support decision-making provides a basis for proactive risk mitigation and collaboration across trading partners. This improved orchestration results in:

- Enhanced supplier relationships by facilitating proactive communication and collaboration with suppliers to identify and inform suppliers of trends and potential supply disruptions
- Improved fill rates, ATP accuracy for customers, and identification of supply disruptions and their impact on ATP commitment dates will provide a better customer experience.

Manage uncertainty and boost resiliency

Lead time prediction advances supply chain resilience by providing advanced warning of probable supply chain disruptions to provide a basis by which GAINS can recommend risk-mitigating actions to:

- Foster risk mitigation strategies such as establishing alternate/secondary suppliers, especially for critical materials.
- Identify the common attributes that cause changes in lead time across items to drive action well in advance of the next time replenishment is needed.
- Support acquisitive growth. Lead time prediction allows an acquirer to use existing data to predict the acquired company's lead times. The GAINS lead time prediction methods lets the acquired company use its lead time prediction model to predict lead times for its SKUs.

Lead Time Prediction Service in Action

Long-time GAINS customer Border States has always been a forward-thinking innovation partner. GAINS and Border States teamed up to engage in an initiative to improve lead-time accuracy and overall supply chain performance.

Border States objectives were to:

- Drive improvements in both customer service/satisfaction and inventory performance.
- Improved abilities to proactively navigate future supply chain volatility and successfully navigate current supply chain and material availability challenges.
- Agility in reducing and mitigating risk driven by market changes and supply chain volatility.

Today, there is unprecedented pressure on working capital as lead-time variability makes it difficult for supply chain professionals, like Border States, to optimize inventory and align on procurement decisions to serve customers. Border States decided they needed to look for a new and innovative way to add value throughout the supply chain and best manage challenges for their customers, vendors, and other employee-owners. They wanted to get ahead of the curve and optimize their inventory to best serve their customers and continue to position themselves for future growth.

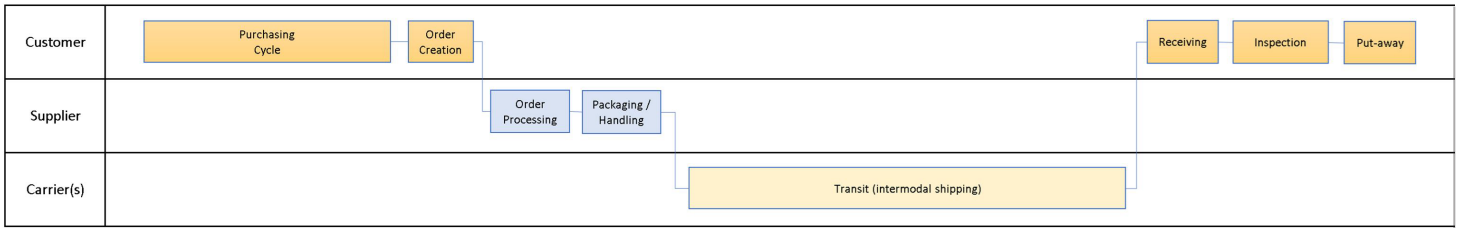
GAINS approach was to improve proactive management of lead-time and service stock by developing ML models to predict supply variability and delivery times of materials with limited or no supply data. Border States and GAINS worked in collaboration to cleanse the model training data, identify the most likely informative features in the data, refine the model, and validate results. At the end of the prototyping the LT prediction model produced a more accurate lead-time on more than two-thirds of the SKUs by Location in the test population. Since the lead-time prediction service has been deployed, Border States has refined their predictions resulting in better service and cost reduction across its network. Benefits achieved include:

- Improving the customer experience and allowing teams to focus on strategic tasks
- Improved line of site and proactive visibility to changes in the supply chain
- More efficient use of working capital
- Aligned inventory and procurement decisions
- 65% more accurate lead times
- 31% reduction in lead time error

Volatility Calls for a New Method to Determine Lead Time

Lead time for externally purchased materials is often calculated through historical data analysis using order receipt data. Using the order create date and order receipt date as lead time can be calculated using different averaging (e.g., weighted moving average). The supplier of materials most often calculates lead time. In GAINS, the lead time calculation does a weighted average at the SKUL level and only uses historical receipt data from the SKUL's stated supplier. Statistical outliers are excluded, and the function will not attempt to calculate lead time if there are insufficient historical receipts. Calculated lead times are often overridden by business rules that account for various scenarios.

Lead time is expressed typically in days or weeks. Often, incremental 'segments' are added to the total lead time to represent the stages of the total order cycle. For example, order planning time, production time or transit time, and order receiving / put-away.



The standard method to determine lead time prediction usually uses statistical methods and the available historical supply data as the primary input for the prediction process. It can calculate the average or weighted average lead time derived from historical supply orders. However, these methods assume that lead time is more or less stable, which may only be realistic in some situations. Since lead time may vary depending on many factors, such as the supplier, the material, and the time of year, these traditional methods are not always effective for correct lead time prediction.

Companies must consider a new method to generate a lead time prediction for materials without any supply history, consider the impact of other features (e.g., vendor features) on the lead time, not just supply data, and be more agile and react to changes in the business environment.

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AI Brings More Accuracy to Lead Time Prediction

Uses the AI technique of supervised ML to create models, the GAINS Lead Time Prediction service provides a better alternative to the existing default lead time calculation. AI/ML algorithms show better results in lead time prediction because they can handle complex relationships and patterns in data and consider multiple factors simultaneously. The models can capture non-linear relationships between the inputs and targets not accounted for by standard average methods. Lead time prediction using AI/ML methods provides more accurate predictions and offers more flexibility in a dynamic business environment.

Machine Learning Models Understand Variability for Better Results

The GAINS Lead Time Prediction service uses models from the boosting algorithms family. These models can capture complex relationships between the input features and target, which helps to achieve better prediction results for use cases such as lead prediction. They can achieve better performance compared to other standard methods. Furthermore, boosting models provide feature importance interpretation that allows companies to identify the most valuable features and better understand the prediction process.

Lead Time Predictions with Little to No Historical Data

The GAINS ML routine for lead time prediction can predict the lead time, as well as the probability of prediction accuracy and supply variability. This new approach works even for materials without supply data since it captures relationships based on other material/location/vendor-specific features.

In addition, the GAINS lead time prediction requires less archival data. It can work only with orders received within the last few months, while the standard method usually requires at least a year of supply history. This method responds quickly to changes and helps to get more accurate prediction results.

The model is trained using historical supply data and information from other material, vendor, and location-level features. The new routine then allows GAINS to predict the lead time for all items, even those without any supply history, which is especially important for new materials. This benefit is also one of the main advantages of the new process compared to the standard method.

The new approach to predict lead time is more accurate since it can:

- Capture non-linear complex relationships between features and target
- Consider multiple features simultaneously
- Handle features with different data types, even categorical variables
- Respond faster to changes, which is crucial in dynamic environments
- Provide visibility into the feature’s importance and how the predictions are generated

The GAINS Lead Time Prediction Service

GAINS Lead Time Prediction is a callable service offering within our composable, service-oriented architecture. It is a stand-alone service that ingests supply and item master data and returns predicted lead times. The service is supported via a stand-alone user interface (UI) that offers prediction explanations and tools to govern prediction deployment. The service empowers planning domain experts to leverage machine learning insights without mastering machine learning tools.

Determine Lead Time Prediction Readiness and Opportunity

Existing GAINS users interested in exploring its lead time prediction's potential value should ask GAINS to verify that archived data is sufficient to support measuring historical prediction errors. As two quick checks:

- Archived item master data should exist at the create date for the vast majority of archived supply transactions, AND
- Sufficient supply data must exist.

If sufficient data exists, GAINS can assess a company's actual lead time prediction error. This quick analysis reveals the scope of potential opportunity and the direction of potential improvement. Suppose a company is chronically overestimating lead time. In that case, this analysis will reveal that eliminating 100% of lead time error could avoid $XXX in annual carrying costs from material arriving earlier than planned. At this stage, GAINS will not know how valuable the ML solution is, only the scope of the opportunity for improvement. If it is significant, GAINS can proceed with exploratory data analysis, data validation, model building, and preliminary value assessment.

About GAINS

GAINS is the supply chain performance optimization company helping companies fulfill their customer's promise. Our first-in-class, best-in-breed composable GAINS Halo360° Decision Engineering and Orchestration Platform transcends traditional silos of ERP, supply chain planning, and network design, enabling integrated, smarter, faster, and composable decisions across the time to plan horizons from strategic design to order execution. Specifically designed to manage volatility, uncertainty, complexity, and ambiguity (VUCA), GAINS customers are able to focus on prioritizing the right decisions at the right time at the right speed and scale to optimize supply chain performance, improving profitability and customer confidence. For more information, visit www.gainsystems.com.

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