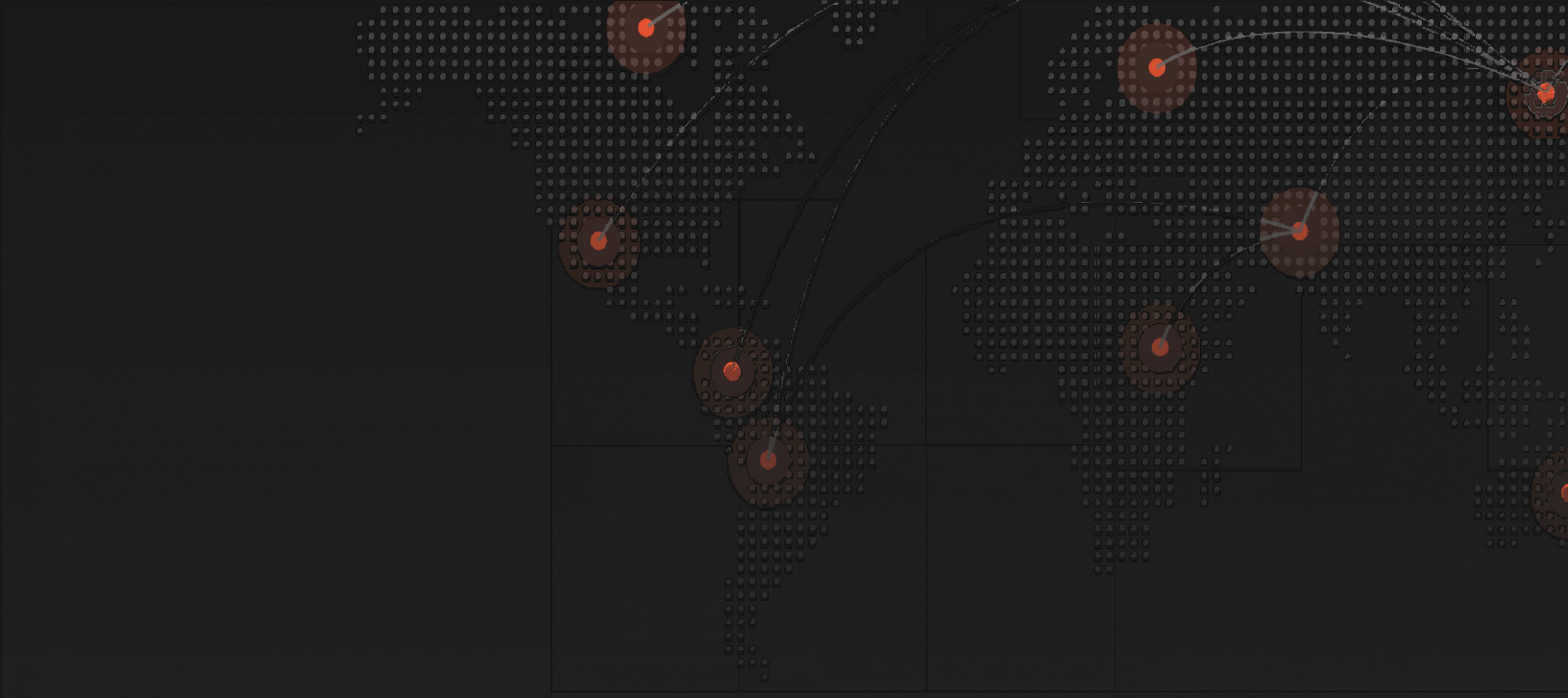


AI-Driven Supply Chain

Build a resilient, predictive, and efficient supply chain that increases visibility while reducing costs and risks

PARAMETRICS
TECHNOLOGY

01

The Challenges of Managing a Complex Global Supply Chain

The pandemic, war in Ukraine, labor and chip shortages, and other global disruptions have served as a reminder that today's global supply chains are extremely fragile. In isolation, each of these disruptions appear to be once-in-a-century events. However, the frequency and magnitude of these disruptive events are growing.

According to the McKinsey report on Risk, Resilience, and Rebalancing in Global Value Chains, manufacturers with complex global operations should expect major supply chain disruptions – events lasting one month or more – at least once every 3.7 years.[1] Causes may include financial crises, geopolitical tension, terrorism, extreme weather, and, yes, pandemics that result in severe financial consequences. Further, gaps in visibility have multiplied as supply chains have become more global and distributed, leading to challenges in monitoring real-time supply network, obtaining delivery data, and generating actionable insights.

With the increasing frequency of disruptions and growing supply network complexity, global organizations are challenged to establish a stronger and more resilient supply chain. Organizations grapple with leveraging the latest technological advancements for a more predictive supply chain to respond to a dynamic and complex world.

In a recent survey[2] by Capgemini Research Institute, 80% of supply chain executives from 1000 organizations across diverse industries (e.g., CPG, retail, discrete manufacturing, life sciences, etc.) shared similar concerns about the stability and resilience of their supply chains:

74%
struggled with shortage of critical parts and materials

74%
also dealt with delayed shipments and longer lead times

69%
had difficulties in adjusting production capacity in response to fluctuating demand

70%
required more than three months to restore operations

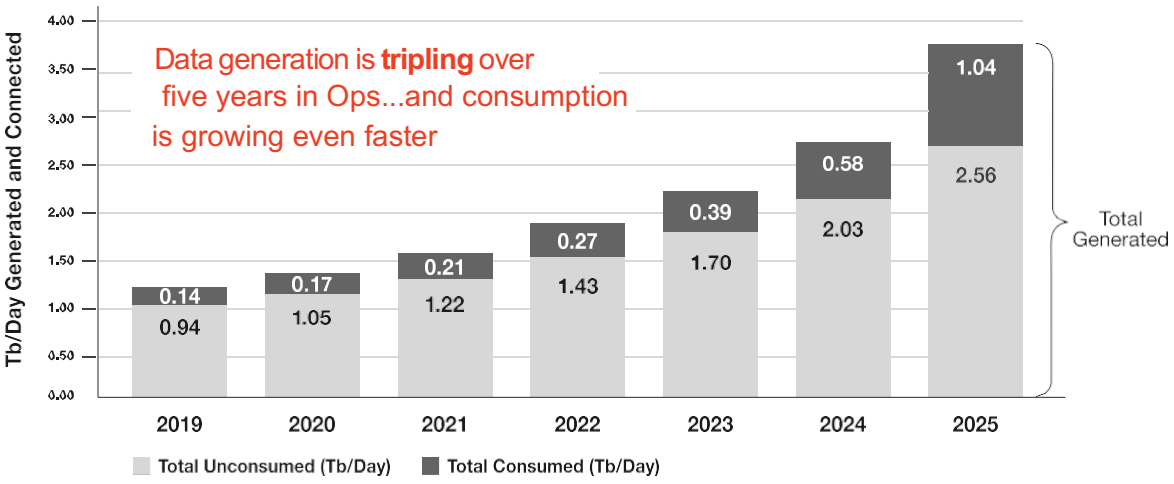
Supply chains have historically faced complexity with the volume and variety of products produced, access to technically savvy suppliers, and trade-related issues. In a now digitally native world, challenges now also include proliferation of data across unintegrated systems, lack of global real-time visibility, demand uncertainties, supplier network risks, and the lack of comprehensive part-level visibility.

Challenges Harnessing Data

Large industrial manufacturers rely on IT and OT infrastructure, systems, and applications to manage their operations and supply chains. Data gathered from the manufacturing environment can identify critical parameters and generate key insights to help drive value for the organization, such as better visibility into the entire supply chain, inventory optimization leading to cost reduction, improved asset availability via predictive analytics, and determining supplier risk using internal and external big data analytics.

However, these data are often locked up in isolated legacy systems and not readily available for value creation by planners and operators. According to IDC[3], the data generated from industrial operations triples every five years, and while data consumption (populating downstream analytics, business intelligence, and AI applications) continues to grow over time, a significant portion (over 70%) remains unexamined, limiting the potential value to be gained from these data.

Data Generation and Consumption in Industrial Operations
(Tb/Day in a Typical $250M Operation)[3]



02

The Supply Chain Reimagined

Recent crises have created near-consensus among supply chain executives about the urgent need to address gaps in their supply chains. An overwhelming 93% reported that they plan to take steps to make their supply chains more resilient, including building redundancy across suppliers, reducing the number of unique parts, and regionalizing or nearshoring their supply chains.[4]

The business environment is now marked by unparalleled speed and volatility, demanding companies to adopt fresh approaches to remain competitive. Agility and responsiveness have become critical attributes for supply chains, enabling organizations to adapt quickly to shifting market demands and unexpected disruptions.

As technological advancements continue to shape the business landscape, companies must embrace innovation in supply chain management. As organizations begin to evaluate and build a more intelligent supply chain, they should consider the following attributes for AI-enabled, intelligent, and resilient operations:

- **The next generation of supply chains** must be able to continuously monitor for variances and delays at every stage, predict their impact, and recommend proactive responses.
- **Any solution** should be designed both for efficiency and dealing with uncertainty.
- **An AI-enabled supply chain** should manage risks with holistic and AI-powered scenario modeling.

Shift to Proactive Response

Supply chains need to transition from a reactive approach to a proactive one to meet the evolving demands and challenges of today's complex and fast-paced business landscape. Adopting a proactive approach involves anticipating and mitigating potential disruptions and bottlenecks before they occur, rather than simply reacting to them after the fact. By leveraging advanced artificial intelligence, predictive modeling, and real-time monitoring, companies can gain valuable insights into their supply chain operations and identify potential risks or opportunities well in advance.

This shift allows for the implementation of strategic measures to optimize processes, enhance efficiency, and improve overall supply chain resilience. Proactive supply chains not only ensure uninterrupted operations but also empower organizations to anticipate market fluctuations, customer demands, and emerging trends, enabling them to stay ahead of the competition and deliver superior customer satisfaction.

Building Plan for Uncertainty

Building comprehensive plans for supply chains is crucial to mitigate risk and uncertainty in today's dynamic business environment. By developing robust plans, companies can proactively identify and assess potential risks, and implement measures to minimize their impact. These plans allow for the development of contingency strategies, alternative sourcing options, and backup inventory management, ensuring business continuity even in the face of unforeseen events.

Furthermore, planning helps to establish clear communication channels and coordination among stakeholders, enabling swift decision-making and agile responses to mitigate disruptions. Additionally, having contingency plans in place enhances supply chain resilience, instilling confidence in customers and partners and safeguarding the reputation and profitability of the organization.

Design for Resilience

Designing a resilient supply chain is paramount in today's volatile and unpredictable business landscape. A resilient supply chain is characterized by its ability to anticipate, adapt, and recover from disruptions while minimizing the impact on operations. To design such a supply chain, several key factors must be considered. First and foremost, diversification is vital, both in terms of suppliers and geographic locations. By having multiple sources of supply and manufacturing facilities spread across different regions, the risk of single points of failure is reduced. Additionally, incorporating real-time monitoring and analytics tools allows for early detection of potential disruptions, enabling timely intervention and response.

Collaborative partnerships with suppliers and customers foster transparency and enable proactive risk management. Implementing agile practices, such as flexible production capabilities and just-in-time inventory management, enhances responsiveness and minimizes excess inventory. Finally, investing in advanced technologies like AI, machine learning, and automation enables efficient decision-making and process optimization. By integrating these strategies and technologies, a resilient supply chain can effectively withstand disruptions, maintain business continuity, and ensure customer satisfaction.

03

How to Optimize and Build the AI-Driven Supply Chain

Traditional systems such as ERP and MRP, legacy data infrastructure, and Excel-based data analysis and reports dominate the supply management workflows today. However, these systems and processes have significant gaps.

As discussed in the previous chapter, the new resilient supply chain paradigm requires speed and agility. Moreover, to effectively navigate the evolving landscape, it is imperative to embrace scalable and flexible AI approaches that enable dynamic responses to rapidly changing conditions. Supply chain teams need to utilize near real-time data from all relevant internal and external data sources and leverage the latest AI and machine learning techniques to accurately predict and recommended optimal operational settings. Supply chain professionals need new computer-human interactions to rapidly access and analyze data in near real time. This is the definition of AI-driven supply chain.

To build this type of supply chain management capability, organizations need a roadmap from an experienced and technically savvy provider with years of AI and ML development experience and key partnerships with leading cloud solution providers. For an end-to-end AI-driven supply chain solution, the provider must address the following use cases:

In Chapter 4, we'll describe the high-level capabilities of each of the core applications belonging to the C3 AI Supply Chain Suite, that are designed to allow large enterprises to digitally transform their supply chain operations using the AI-driven supply chain. With this approach, organizations are empowered to address the gaps that have long been associated with legacy data infrastructures and supply chain management systems.

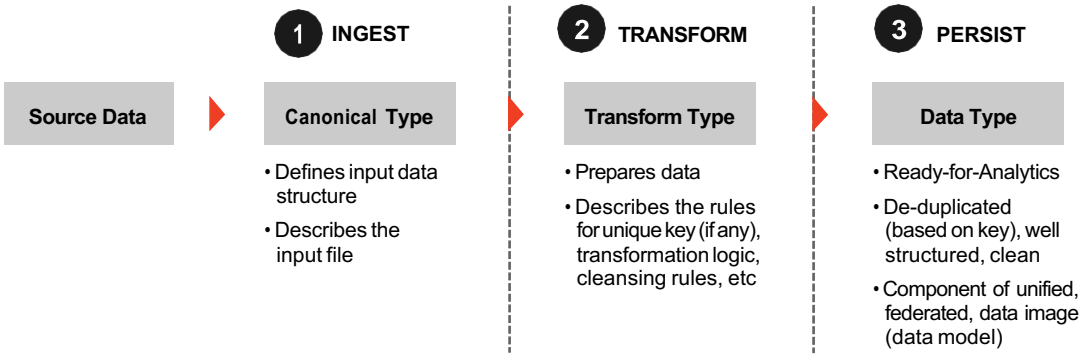
FEATURE	TRADITIONAL APPROACH	AI-DRIVEN SUPPLY CHAIN
Data Sourcing	**Inconsistent** data in silos	**Unified** data from all sources
	Weak demand signals	**Specific** demand signals
	Limited supplier data	**Supplier** and transportation data
Insight Generation	**Mostly** manual updates	**Real-time** updates
	Traditional rules-based approach	**AI-based** models with continuous self-learning
	Static forecasting	**Scenario** analysis and simulations

Create a Supply Chain Digital Twin

A supply chain digital twin is a virtual replica and a parallel version of an organization's physical supply chain and its supplier network. Like the physical world, the digital network is interconnected and vast – representing millions of SKUs, thousands of suppliers and customers, hundreds of warehouses and logistics centers, and innumerable routes connecting each node. This supply chain digital twin provides end to end, granular traceability of materials and goods from source to destination. It contextualizes movements and activity across logistics networks with external factors, providing all relevant information to make sense of what has happened and is going to happen at any point across time and space of the supply chain.

By deploying a supply chain digital twin, an organization gains unprecedented visibility, and therefore predictability and control, into its distributed and interconnected production networks.

The sources of supply chain data in large manufacturing organizations are often legacy enterprise systems such as ERP, MRP, Analytics and CRM systems. Other relevant data include demand forecasts, planning calendars, and sensor data, as well as external sources such as weather, GIS, market data, social media, pricing, and any other relevant data. To start, data must be ingested, deduped, cleansed, transformed, normalized, and finally prepared for analytics.



The federated data model is created by storing and mapping multiple independent databases into a single virtualized database. In this model, the autonomous databases that host the source data are interconnected over a computer network and are often geographically distributed and decentralized. The work of applying machine learning models starts once the data have been unified. By connecting the data image to an organization's IT and OT environments, including the internal and external data feeds, it is now possible to dynamically update the overall view of the supply chain as internal parameters and environmental conditions fluctuate or as significant changes to input data are recorded (e.g., if a major supplier begins operations from a new country).

In addition to gaining access to a globally unified view of their supply chain, organizations can conduct 'what-if' scenarios with the option to measure and analyze the impact of different demand and supply variables, replay demand forecasts, and test contingency plans. In summary, supply chain digital twin benefits include:

- End-to-end visibility and longitudinal tracking
- Improved decision making by conducting simulations
- Enhanced supply chain design
- Cost savings with early issue detection
- Improved productivity

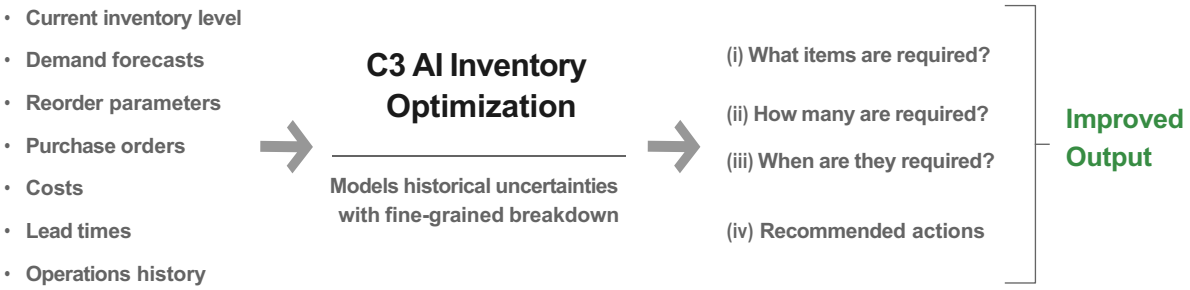
Ingest Data and Make Recommendations in Real-Time

In a traditional operation, supply chain planners and managers are typically forced to work with inconsistent and outdated data. This results in manual processes to adjust inventory levels, evaluate risks, and generate sub-optimal plans.

AI-enabled supply chain solutions offer a quantifiable shift from traditional manual operations to the creation of data-driven, automated, and predictive real-time recommendations. AI-enabled supply chains can receive demand signals as they arrive, updating demand forecasts and supply risks dynamically. This provides companies with greater agility, while ensuring that the supply chain is recognizing and resolving risks as they occur.

AI-enabled supply chain management applications model uncertainties to allow supply chain professionals to optimize re-order parameters by part and by location and to gain visibility throughout their supply chain operations. For example, supply chain professionals can now identify vulnerable sources of raw materials or weakness in hubs and aggregation points. Planners and operations managers gain insight into potential delays and recommendations that result in improved OTIF performance leading to increased customer satisfaction. C3 AI Inventory Optimization is an example of an AI-based application that combines supply chain digital twin functionality with AI and machine learning models that improve visibility, reduce inventory holding costs and increase productivity of inventory analysts through automated recommendations. This application is designed to model and learn from uncertainties and provide recommendations that are used as inputs into existing MRP modules.

AI-Based Approach



Apply AI to Your Highest-Value Use Cases

Demand forecasting, planning and production scheduling teams can benefit significantly from the use of enterprise AI. These teams typically rely upon manual tools and processes that operate on outdated data and historical trends to make planning decisions. To make matters worse, teams typically use rules-based statistical approaches that fail to evolve with changing market conditions. This often results in suboptimal outcomes with significant downstream impacts. For example, inaccurate demand forecasts for a newly launched product where there is no historical sales data can lead to poor inventory management with excess inventory and additional holding costs, or reduced service levels from insufficient safety stock.

An AI-enabled demand forecasting application is able to unify internal and external data to generate precise, fine-grained, and dynamic demand forecasts. AI algorithms model each location, customer, and product SKU using their unique characteristics and dynamically update forecasts with changing market conditions and customer preferences. With an AI-enabled application, demand planners can more accurately forecast demand, lower inventory costs, improve order fill rates, and drive operational efficiencies.

Similarly, production planning and scheduling can benefit significantly from AI-enabled applications. In this case, these applications consider constraints including equipment configurations, material availability, staffing calendars, and line utilization to translate the forecasting and planning outputs into optimized manufacturing and distribution schedules.

By using a ull featured AI-enabled application, planners can capture all forecasting, planning and scheduling constraints that change over time, including parts and equipment availability, asset performance, cost and staff readiness to include in supply chain processes.

Increase organizational adoption with Generative AI capabilities

The integration of generative AI in supply chain software applications has the potential to significantly enhance adoption and drive transformative outcomes. One key advantage lies in the ability of generative AI to facilitate rapid and easy access to enterprise information. By leveraging this technology, organizations can swiftly retrieve crucial information, perform analyses, and utilize predictive analytics derived from both internal and external systems. Furthermore, the generative AI solution respects access controls, ensuring that authorized individuals, including executives, managers, domain experts, line workers, developers, and even customers, can access relevant information and insights tailored to their specific roles and permissions.

To incorporate generative AI into the AI-driven supply chain, organizations require a solution that is flexible, adaptable, and can be seamlessly integrated into their pre-existing supply chain software infrastructure. By providing an unforseen level of customization and compatibility, generative AI paves the way for widespread adoption and enables organizations to leverage the full potential of AI in optimizing their supply chain operations.

04

AI Supply Chain Suite Applications

AI Inventory Optimization

Our AI Inventory Optimization applies advanced AI, machine learning, and optimization techniques to help manufacturers right-size inventory levels at any stage of production (e.g., raw material, work in progress, finished goods) while maintaining sufficient safety stock for the production process.

22%
Inventory savings for SKUs in scope

6 months
From kick-off to production-ready

10K SKUs
Representing $200M in inventory made visible

Reference: C3 AI Inventory Optimization, Fortune 500 Electronics Manufacturer case study

AI Inventory Optimization benefits include:

- **Reduction in inventory holding costs** and improved cash flow without compromising part availability
- **Improved service levels** to customers
- **Reduction in total landed costs** that includes standard and expedited shipping costs
- **Improved visibility** of critical uncertainties such as seasonality in demand, uncertainty in arrivals, quality issues from suppliers, and production-line disruptions
- **Improved ability** to manage and negotiate with suppliers
- **Improved organizational efficiency** through a common view across various teams such as materials management, supplier management, logistics team, etc.
- **Increased productivity** of inventory analysts through automated recommendations based on new data and live integration with operational systems

AI Supply Network Risk

AI Supply Network Risk provides supply chain and order management professionals with unprecedented visibility into the status and delivery risks of customer and supplier orders and a set of actionable recommendations to ensure on time and in full (OTIF) delivery of customer and supplier shipments.

35%
Reduction in delayed sales orders

4 weeks
For initial production deployment

50M
Rows of data unified across four disparate systems

Reference: AI Supply Network Risk, Global HealthTech Company

Employing advanced machine learning algorithms and models, our AI Supply Network Risk predicts order lead times and identifies delivery risks. For orders at risk of delay, our AI Supply Network Risk rapidly identifies remediation options including shipment from a different facility, moving inventory between facilities, reprioritized sales order lines, accelerating delivery from supplier, and modifying sales order for users to action.

AI Supplier Network Risk benefits include:

- **Improved customer satisfaction** by ensuring OTIF delivery by identifying customer orders at risk and executing remediation options
- **Improved production reliability and quality** through advance notification and preparation of backup supply options specific to individual product lines and geographic supply and delivery chains
- **Increased flexibility of the supply chain** through predictive identification of specific portions of the supply chain with extra capacity or available redundancy

AI Production Schedule Optimization

AI Production Schedule Optimization (AI PSO) is an enterprise AI application that generates dynamic manufacturing and distribution plans and schedules using a holistic view of customer demand, supply chain, manufacturing, and distribution operations.

AI-enabled optimal manufacturing and distribution schedules can unlock $10M-$100M in value.

Reference: Parametrics AI Internal Research, 2021

AI PSO reduces transition, inventory, transportation, staffing, and other costs by deploying optimally allocated tasks to resources at the right time, in the right order, and at the right capacity. By reducing the gap between planning and scheduling, manufacturers ensure that customers get their orders on time and in full (OTIF).

AI PSO benefits include:

- **Improved ability to meet customer demand** – Optimize the end-to-end process to ensure each manufacturing and distribution asset is optimally utilized and that customers get orders on time and in full
- **Maximized high-margin products throughput** – Precisely prioritize high-margin products across the manufacturing and distribution chain by deploying resources at the right time, in the right order, at the right capacity with optimal scheduling
- **Minimized distribution scheduling costs** – Cut down on transition, inventory, transportation, staffing and other costs by deploying optimally allocating tasks to resources at the right time, in the right order and at the right capacity
- **Minimized last-minute planning and scheduling changes** – Predict orders likely to be modified using AI and update planning and scheduling accordingly
- **Increased departmental efficiency** – Align Sales, Marketing, Purchasing, Planning, Production, and Distribution activities behind one planning and scheduling suite

Parametrics AI Sourcing Optimization

Parametrics offers AI Sourcing Optimization, a new supply chain application to optimize supplier and sourcing operations. Our AI Sourcing Optimization applies AI and machine learning techniques to help enterprises reduce costs, minimize risks and increase efficiency.

10%
Reduction opportunity across sourcing costs

$10-20M
In identified savings opportunities

500+
Enterprise users

Reference: Parametrics AI Sourcing Optimization for a Multinational Industrial Manufacturer

Optimize sourcing strategies and reduce procurement costs with **AI Sourcing Optimization.**

Our AI Sourcing Optimization identifies the lowest prices paid for parts to allow sourcing of new orders or adjustment of existing orders at the best possible price. Additionally, it identifies performance, tracks and analyzes purchase orders across parts/vendors/facility, identifies availability of inventory, and provides a single, unified view into global sourcing operations.

Our AI Sourcing Optimization benefits include:

- **Reduced sourcing costs** by proactively identifying the lowest cost suppliers across items
- **Minimal price leakage** through continuous monitoring and benchmarking of item prices across historical orders, other suppliers, and market price indices
- **Improved supplier performance** through continuous monitoring and benchmarking across peers
- **More resilient downstream supply chain** by minimizing fulfillment risks and order delays early on
- **Improved sourcing efficiency** through global visibility across all sourcing activity for sourcing managers and supply chain executive

Parametrics AI Demand Forecasting

Parametrics AI Demand Forecasting is an enterprise AI application that applies advanced artificial intelligence and machine learning techniques to help large, complex organizations more accurately and efficiently forecast demand to improve service levels.

Parametrics AI Demand Forecasting provides demand modelers with a combination of rule and AI/ML-based segmentation capabilities, including unsupervised clustering, that enable both automated and dynamic segmentation based on demand profile, data availability, and other characteristics. Our AI Demand Forecasting supplies over twenty out-of-the-box AI models for both demand forecasting and demand sensing, including models for data cleaning (e.g., anomaly detection, imputation) and time series forecasting (e.g., deep learning, ML-based autoregression).

11.7%

forecast accuracy lift across more than 300 SKUs

15.1%

forecast accuracy lift across 120 SKUs that were the most difficult to forecast

Automatically track forecasts **with potential issues with data-driven exception management within application**

Our AI Demand Forecasting benefits include:

- **Improved operational efficiency and reduce supply-related costs** by providing more accurate demand forecasts to production and purchasing teams, ensuring capacity and scheduling align with customer demand
- **Improved order fill rate and increase customer satisfaction** through more accurate demand forecasting
- **Improved service levels** and increase customer satisfaction through more accurate demand forecasting
- **Improved planner productivity** and reduce the overall demand planning cycle time

05

How It Works

Case Study: Global Discrete Manufacturer

Company

A leading North American discrete manufacturer operates hundreds of factories globally and makes highly complex industrial equipment. It generates approximately $30 billion in annual revenue, has 60,000 employees and has been in operations for nearly 180 years.

Challenges

The company's products are configured with hundreds of individual options leading to products with thousands of permutations. The customized nature of each product drives significant complexity in managing inventory levels during the manufacturing process. Since the final configuration of a product is often not known until the order is submitted for production, factories often hold excess inventory to fulfill their orders on time.

Like other manufacturers in the industry, the company had deployed Material Requirements Planning (MRP) software to support production planning and inventory management. Prior to engaging with us, the company had also experimented with various inventory optimization software. However, the existing software solutions were unable to dynamically optimize inventory levels of individual parts at scale while also managing uncertainty and learning continually from new data.

Solution

To reduce inventory cost and improve analyst performance, the customer selected the Our AI Inventory Optimization application for one product line at one factory. Parametrics developed an algorithm that dynamically optimized reorder parameters (i.e., safety stock, safety time) and avoided stock-out of parts with a specific confidence level. This was accomplished by collecting, loading and processing data from production orders, product configurations, BOMs, parts movement events, historical settings of reorder parameters, lead time and shipping costs from suppliers.

Implemented Our AI Inventory Optimization

3 Years
of historical data on production orders, BOMs, reorder parameters, and movement events of parts within factory

42
individual files across 11 legacy source systems

9M **rows of data**

Our AI Inventory Optimization application applied a machine learning and stochastic optimization algorithm to learn from variability in demand, supplier delivery times, quality issues, and production disruptions to dynamically and continuously optimize reorder parameters and minimize inventory holding and shipping costs for each part.

The Results

The savings from reduced inventory holding costs far exceeded the customer's expectations. Through the trial, we was able to identify 25-35% savings in inventory holding costs, and when scaled across the customer's locations, represented a savings of $100 - $200 million annually.

25-35%
Savings in inventory holding costs

$100-$200M
Annualized savings

06

Ready to Get Started?

Learn how to build foundational capabilities, accelerate deployment, and achieve supply chain resiliency with Our AI Applications.

Contact Sales

Learn More

View Case Study

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