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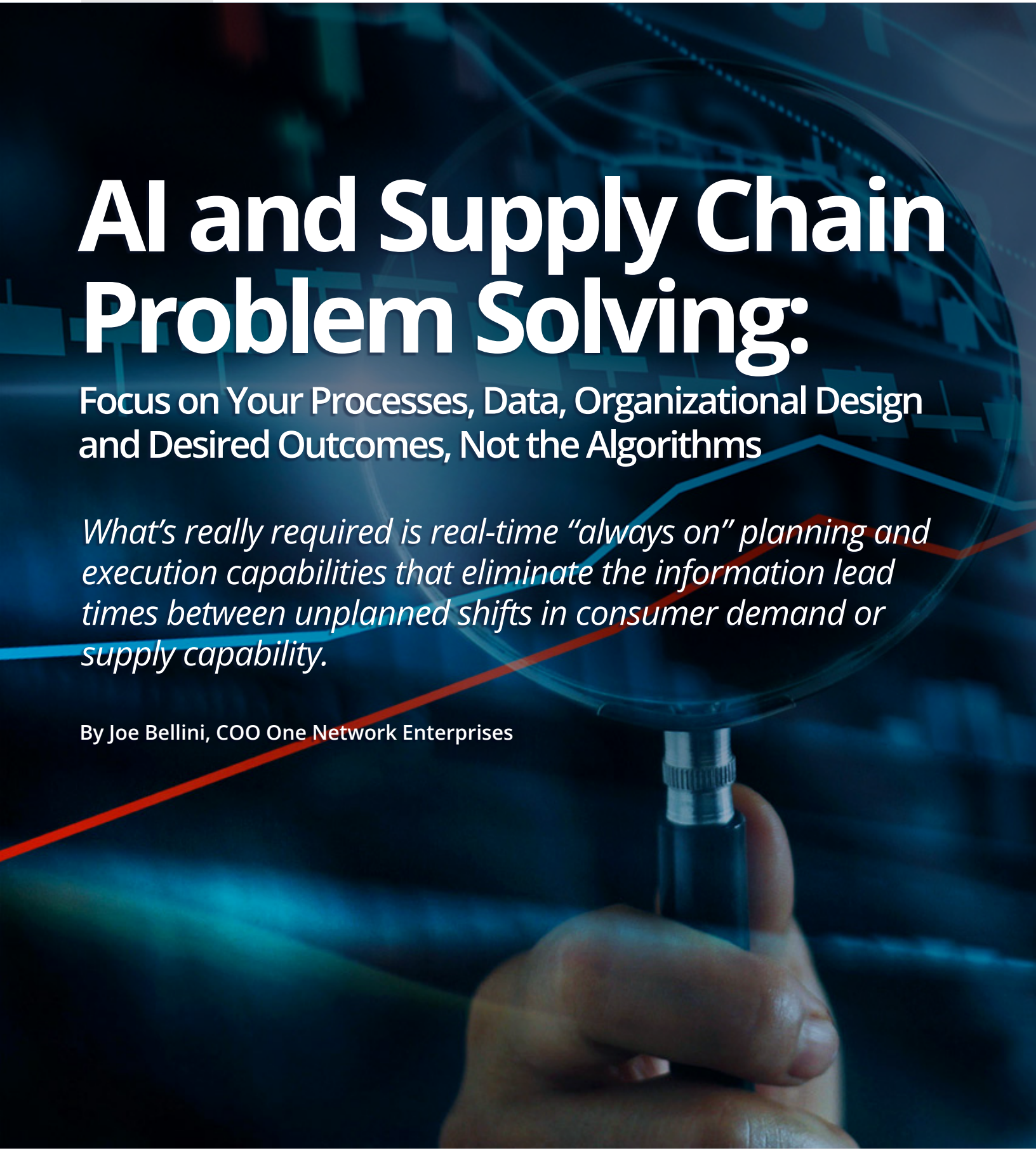


AI and Supply Chain Problem Solving:

Focus on Your Processes, Data, Organizational Design and Desired Outcomes, Not the Algorithms

What's really required is real-time "always on" planning and execution capabilities that eliminate the information lead times between unplanned shifts in consumer demand or supply capability.

By Joe Bellini, COO One Network Enterprises

The big joke among us mathematicians in today's competitive landscape is that "We market around AI, recruit around ML, and apply regression when problem solving!"

In reality, regression still makes up a big part of our analytical activities. Further, we still apply quite a mix of mathematical approaches to solve for real world problems in our supply networks including:

- Rule-based engines to make decisions around alternate sourcing or substitute parts
- Heuristics for use in supply and demand netting
- Algorithms for use in optimizing to objectives like revenue, cost, or profit
- Now expanding into machine learning, which we can apply when extending the data model to include new vectors such as weather and traffic patterns
- Finally, deep learning for true pattern recognition

Let's think about what is really happening in our supply network. The ecosystem is rewarded when an end consumer purchases a product or service. Let's call this time zero or the "moment of truth". Now let's travel backward in time from this moment of truth through our supply network - hours prior to purchase, days, weeks, and months.

Yesterday's systems will certainly enable monthly, weekly, or even daily planning and execution but this is no longer enough. Real-time "always on" planning and execution capabilities that eliminate the information lead times between unplanned shifts in consumer demand or supply capability are required. This demand driven value network enables a single version of the truth across the network of trading partners and becomes the foundation that autonomous agents rely on to get the job done. Every hour of information latency which is removed from the network can result in significant increases in customer satisfaction, sales, inventory improvements, and working capital reductions. The platform must enable incremental improvements to plans and schedules focused on problem areas which weren't possible in the past, since it required a replan of an entire network to make changes.

SO HOW DO WE MAKE IT ALL HAPPEN?

Well, we've heard it before - it's all about the data. In the past, companies have struggled with the notion of applying autonomous agents across supply chain networks. The general consensus has been this is due to the black box nature of the algorithms and the lack of high-quality data across network trading partners, along with the human bias contained in some of the available data.

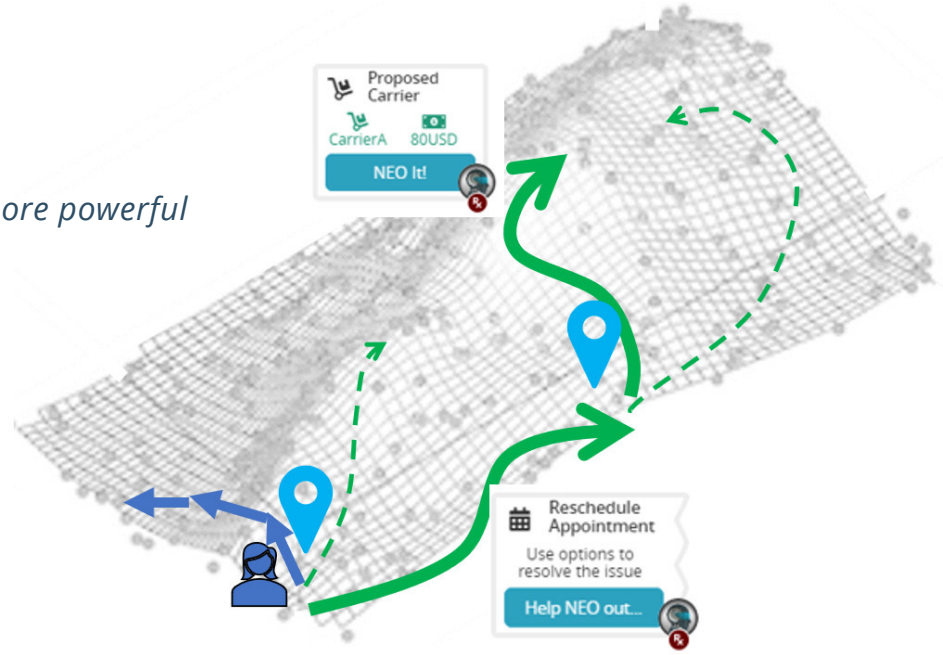
Looking deeper, we find that this data problem has been somewhat self-inflicted. While our desire has evolved to running a collaborative partner-based ecosystem across our trading network, we have unfortunately been trying to do this by extending our enterprise-centric view of the world. Full collaboration across the partner ecosystem requires a data infrastructure which flows seamlessly from planning to execution both within the enterprise as well as across all network tiers, vertically and horizontally. In addition, planning and execution workflows must support multiparty transaction processing, given that no company is an island in today's supply network ecosystem.

One Network's platform representation includes all customers, channels, logistics, manufacturers, co-manufacturers, suppliers, 3PL's and more - basically all trading partners across the supply network ecosystem. Further, data cross-referencing is supported along with capabilities like available-to-promise (ATP) and attribute-based search on a global basis. Data exists only once on the network through a federated master data management (MDM) framework. Onboarding to the network is a straightforward process and mostly self-service for carriers and suppliers. Access to data and transactions for all network participants is governed by a patented permission framework administered by the owner of the data, whether it be master data, meta data, or transactional data. This then solves the data problem.

DELIVERING TARGETED OUTCOME

Now the question becomes how best to apply the right mathematical approaches for problem solving and delivering on targeted outcomes, such as highest customer service levels at the least landed cost. Let's think about all the decision options represented in the three-dimensional solution space below. In it, the higher the elevation, the more optimal the solution. How does this relate to the decisions carried out every day in a typical corporation? We can use a real case study from One Network to explain.

Roles become more powerful



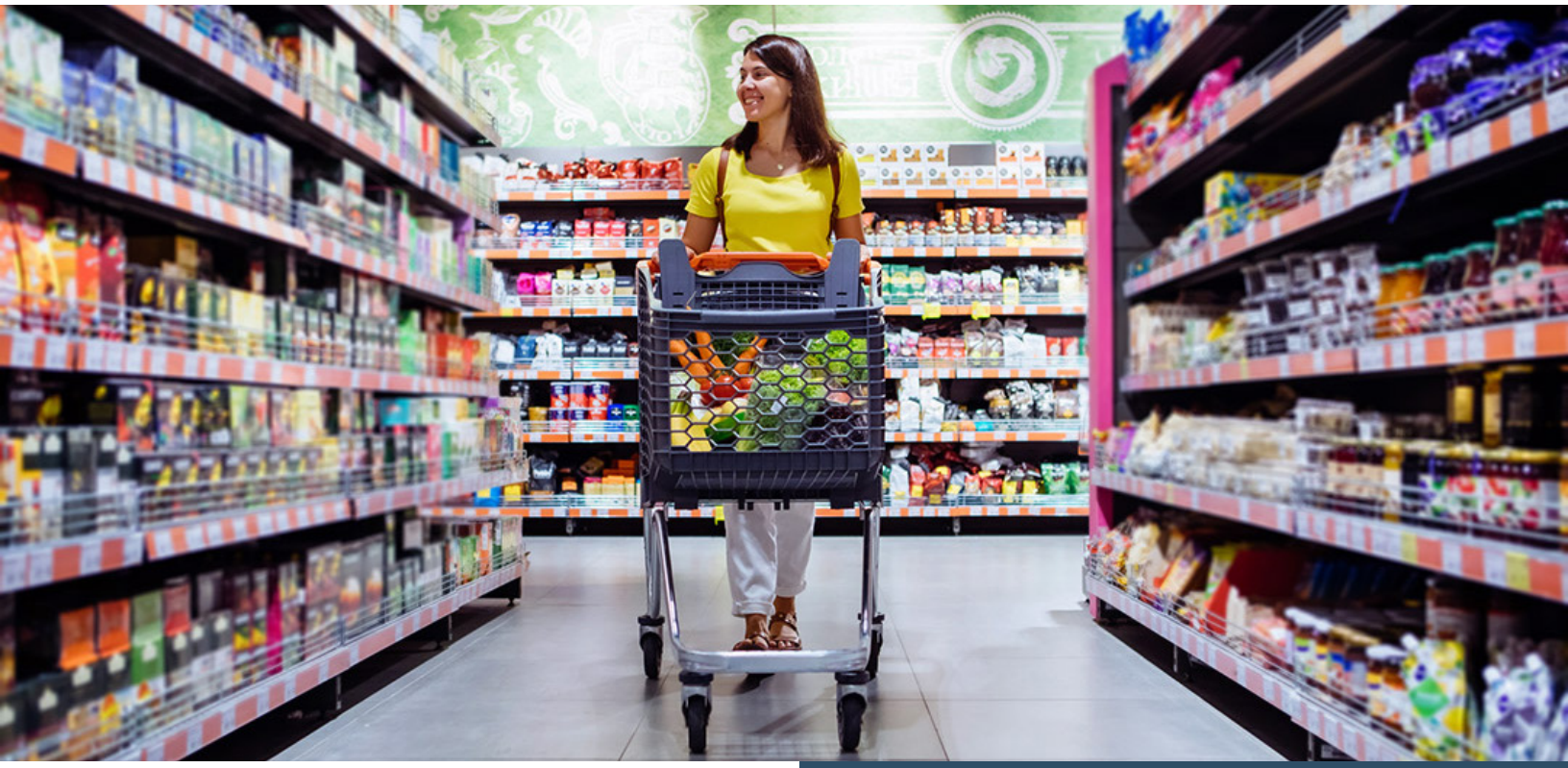
CPG CASE STUDY

A large CPG manufacturer was meeting service level needs by carrying 65 days of supply, which is typical of most large CPGs. They also relied on the typical static lead times for both orders and logistics that are part of an ERP deployment, along with significant information latency among trading partners, given everyone wants to run a local optimization prior to passing new data/information to the next node. In this typical network, there are 21 competing optimizations running from end consumer upstream through the supply base! As a result, promotional in store/in stock was running at only 80% and with 40% of revenues being driven through promotions, the opportunity for improvement was tremendous.

On the bottom left of our solution space above, we find the typical planner/scheduler/expediter doing their job as they have been trained to do, using whatever planning and execution systems they have available. As problems occur in the network, whether they are planning problems that are solved prior to material being in motion across the network, or execution problems once material is in motion related to an order, they solve those problems using excess inventory, lead time, expediting, and capacity, resulting in poor service levels, out-of-stocks (OOS), etc. Yet given the limitations of their processes and systems, everyone feels they are doing a good job, or at least doing what they were trained to do based on tribal knowledge.

What if we wanted to solve for problems and achieve a better solution represented by a higher point on the solution landscape? That is represented by the journey where the planner/scheduler/expediter executes a series of decisions by leveraging AI which brings them to a high point in the solution space. In our CPG example, this higher point represents 99% promotional in stock, thus achieving significant value as compared to the prior 80%. And this was achieved while also lowering inventory from 65 days to 25 days and reducing the number of planners from 13 to 6. A true high point in the potential solution space, rather than the legacy solution represented by the bottom left – which was still a viable solution, but certainly in no way optimal for the business.

These decisions, which take you to a higher point in the solution space, are supported and enabled by One Network's advanced NEO Workbenches where you can evaluate the projected outcome based on decisions you take, thus removing the "black box" nature of AI-enabled decision making. Once you are comfortable with the decision outcomes generated by the Workbenches, you can then take the next step and set your KPI guardrails for autonomous decision making -- and thus enable high value robotic process automation (RPA) which is far superior to some of the trivial applications that we have seen in the market.



Taking your RPA a step further, similar to grandmaster in chess, NEO will recognize decision patterns that continually result in higher points on the solution space above. NEO will remember the conditions and situations – vectors – when certain decisions were made that led to improved outcomes – all contextual and temporal in nature, based on the real time state of the underlying multi-tier, multiparty supply chain network. These patterns can then be laid into your decision making as future RPA, and can be designed incrementally if desired, as part of a Workbench for sequenced decision making.

CORRELATION-BASED AND CAUSAL-BASED AI/ML

Let's dig further into AI decision making and specifically machine learning (ML). ML usage has been somewhat centered on correlation-based outcomes and can help us understand how features relate to outputs - which has given us significant advancements in areas like forecast accuracy. However, predictive analytics from a supply chain network perspective tend to be more causal in nature. Using ML to understand cause-and-effect in complex systems can drive significant improvements, as in our CPG case study.

CORRELATION means there is a relationship or pattern between two variables. A scatterplot can be a useful tool for determining if there is a correlation between the variables.

CAUSATION means one event causes another event to occur. Causation can be determined in a designed experiment, as when similar groups receive different treatments, and the outcome of each group is studied. A treatment causes an effect if the groups have noticeably different outcomes.

Although causation and correlation can occur at the same time, correlation doesn't mean causation.

The potential applications of ML in supply networks are broad in that you can:

- Evaluate supply network resiliency and continuity strategies from a planning perspective
- Compare different inventory policies at multiple tiers within your supply network as they relate to cost, capacity, and customer service levels
- Decide which course of action to take in making sure a projected late order arrives on time in the coming days or even hours

Of course, the RPA overlay discussed in the example above generates a whole new level of AI based capability in terms of understanding causal-based decision patterns which lead to much higher levels of performance. This capability will drive a complete rethinking of organizational structures moving forward related to planning, scheduling, and execution, given that tech enablement drives more powerful roles with real time decision capability across the trading network.

Within the NEO platform your team will have the ability to run full "what if" analyses across the entire network that are both correlation and causation based. And any of you thinking that a digital twin is a different layer in your solution space as compared to your supply chain network platform….it isn't. You get your causal digital twin as an extension of your real time and demand-driven supply chain network solution, that is both multi-tier and multiparty. The network is fully IoT-enabled from just about every data feed known to mankind… or has the canonical/API to accept the feed.

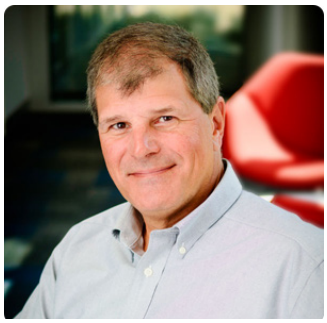
In one of my previous papers, I discuss the fact that planning and execution are not two different things. The temporal nature of decision making, whether it is in the Sales and Operations Planning (S&OP) realm 6 to 12 months out, or in the Sales and Operations Execution (S&OE) realm happening in the next few days or hours, are comprehended by this framework. Predictive analytics are temporal and spatial as well as contextual. The fact that the supply chain network in NEO has full physical and logical asset representation from the end consumer up through the tier-2 supplier is key. This provides both the spatial and temporal infrastructure required for causal-based predictive analytics. For example, your IoT inputs are time series in nature. Your causality is going to be both real time and lagged projected forward.

This entire line of thought that I'm presenting in this paper hasn't really been investigated in the past from a supply chain network perspective. The reason is that we have been caught in the static world of ERP hub-and-spoke architecture and thus weren't able to take advantage of a more dynamic environment or workflow. Now with One Network's NEO, we suddenly have a dynamic, real time, demand driven network-based platform architecture that is a combination of algorithmic and human/collaborative interaction for decision making.

DRAMATIC RESULTS WITH AI/ML

In the case study discussed earlier, the AI-enabled NEO platform delivers on both correlation and causal based AI/ML to drive decision making higher in the solution space, both interactive and autonomous. The result is higher performance in your supply network than can be achieved with competing solutions. "What-if" capabilities in terms of causal-based decision making are provided through interactive Workbenches with projected results displayed through permission-based dashboards and available for full trading partner collaboration across the network.

The results speak for themselves with higher levels of customer service, least landed cost, lower inventory levels, decreased expediting costs, operational improvements, increased production levels, and decreased labor costs through tech-enabled role consolidation.



About the Author

Joe Bellini is certified in AI/ML from the MIT Sloan School, is an alumnus of Harvard Business School, and has degrees in Applied Mathematics and Statistics and Mechanical Engineering. He is a past award winner in the Mathematics Olympiad competition and has been listed by Supply and Demand Chain Executive Magazine as a Pro to Know for the past 2 years.

ABOUT ONE NETWORK

One Network is the leader in intelligent control towers for autonomous supply chain management. From inbound supply to outbound order fulfilment and logistics, this multi-tier, multiparty digital platform helps optimize and automate planning and execution across the entire supply network and every trading partner. Powered by NEO, One Network's machine learning and intelligent agent technology, real time predictive and prescriptive analytics enable industry-leading performance for the highest services levels and product quality at the lowest possible cost. It's the industry's only solution with a fully integrated data model from the consumer to suppliers and all logistics partners, providing a network-wide, real-time single version of the truth. Leading global organizations have joined One Network, transforming industries like Retail, Food Service, Consumer Goods, Automotive, Healthcare, Public Sector, Telecom, Defense, and Logistics. Headquartered in Dallas, One Network has offices across the Americas, Europe, and APAC. For more information, please visit www.onenetwork.com

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