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Six Tips for Success Using Machine Learning for Demand Planning

Important points every supply chain organization should consider before diving into a machine learning project

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INTRODUCTION

Machine learning—it's a ubiquitous buzzword that's used loosely but at the same time widely misunderstood. Like many powerful technologies, machine learning has the potential for great business benefit, but if wielded in the wrong way can result in wasted time and resources, and poor business decisions. Remember the saying, 'a stitch in time saves nine'? The key to sustainable supply chain benefit from machine learning lies in taking a thoughtful approach at the outset: establishing goals, devising a strategy, testing results and refining your approach as you go.

We've compiled six important tips for businesses considering applying machine learning to supply chain planning problems, based on our nearly 10 years of experience building and delivering machine learning solutions.

First, let's take a quick look at the machine learning process, and why it's a great fit for demand planning challenges.

Machine learning is a type of artificial intelligence (AI) that enables computers to learn and get smarter performing tasks without being explicitly programmed.

What's the Machine Learning Process?

At the highest level, machine learning enables a system to learn from experience (data), rather than being explicitly programmed to behave in a certain way. The typical machine learning process is highly iterative, and includes the following steps:

01 Data Gathering

Acquisition and storage of relevant structured and unstructured data sets.

02 Data Preparation

Exploratory data analysis, cleansing, transformation, feature engineering, and selection, training and test data set split.

03 Model Selection

Domain appropriate choice of supervised, unsupervised or reinforcementa learning algorithm(s) (e.g. K-means clustering, decision trees, neural networks, etc.).

04 Training

Train the model with the training data set.

05 Evaluation

Measure the performance of the trained model on the test data set against a defined evaluation metric (e.g. achieve a forecast accuracy of at least 85%).

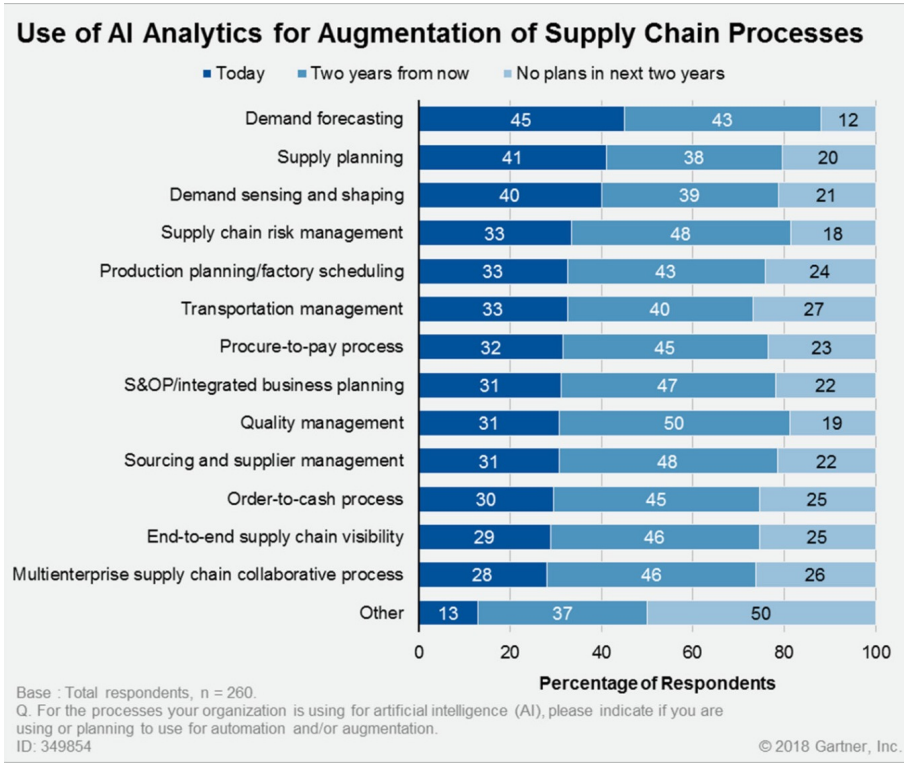
06 Hyperparameter Tuning

Empirical process of changing algorithm parameters to improve model performance.

07 Prediction

Deploy the trained model in a production system environment

Sound a bit intimidating? Fortunately, the right machine learning technology partner can automate and simplify these steps with self-learning models that react to changes in your business. That means you don't need an army of data scientists to incorporate machine learning into your demand planning.



(1) Gartner--Current Use Cases for Machine Learning in Supply Chain Planning Solutions. 19 May 2018 - ID G00349854

The Demand Planning Problem

A Perfect Fit for Machine Learning

Business problems that leverage demand planning, including those related to demand forecasting, sensing and shaping are prime candidates for using artificial intelligence to help automate supply chain processes. And for good reason: increasing forecasting complexity and rapidly shifting consumer demand are often exacerbated by seasonality, new product introductions, promotions, and myriad causal factors (e.g. weather, social media), making demand planning extremely complex. Today businesses are using machine learning to address these processes more than any other area of supply chain planning (see image).

Demand planners are also asking for help. "They want to get better, more accurate demand plans that do not involve absorbing masses of demand planner time to accomplish. In essence, they want more productive demand planners who can go off to participate in more of the interpersonal relationships part of their roles with their supply-side and sales and marketing colleagues"[1]. The time saved by leveraging machine learning provides a means to achieve quantifiable business improvement.

Read on to learn tips for successfully incorporating machine learning into demand planning processes.

Setting and tracking machine learning initiatives is often part of a company's S&OP/integrated planning initiative.

#1. Set Specific Business Objectives at the Start

With all the buzz about machine learning, it's tempting to want to go from zero-to-60 with machine learning. Unfortunately, the transition requires a more moderated approach to achieve success. Without baseline metrics on what you want to improve on and why, how can you be confident your strategy is working? Having a solid charter of what you want to accomplish and why is essential before charging down the machine learning path.

Gathering the necessary data to formulate an accurate comparison between previous results and those provided by machine learning is an excellent way to establish confidence in your results. And because machine learning systems get smarter over time, having a consistent method of measurement is even more important to ensure you can accurately track how outcomes and ROI are improving against established metrics.

#2. Walk Before You Run: Start Simple and Layer in Complexity

After you've established your project objectives, it's time to build a solid baseline/foundation for a successful and sustainable initiative. We've found that the best approach is to leverage both probability forecasting and machine learning technologies, which work together seamlessly and automatically, giving users the ability to forecast at the most granular level, on different time horizons. This walk, then run approach begins with establishing an adaptive, probability-based model for demand forecasting using existing historical data, then layering in more sophisticated machine learning using external data sources. A reliable demand forecast is critical to success with advanced machine learning and yields significant benefits on its own.

A machine learning technology partner can guide you through your journey, establishing a solid foundational baseline model on which to layer more and different types of data. A phased approach will help ensure a sustainable machine learning solution that meets your business objectives today and as your needs change.

The allure of leveraging external causal factors and unstructured data with machine learning can be extremely intoxicating and may be very impactful in time. The best way to determine whether it is meaningful and to what degree can only be determined through a methodical approach designed to gain insight with each successive iteration. Building manageable sprints give you the opportunity to change course based on what you learn along the way, drawing out meaningful correlations with each iteration.

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What's Probability Forecasting?

Instead of traditional "one number" forecasts, probability forecasting helps you understand the range of possibilities of demand in your forecast. Using this approach, you still get one number that's associated with the most probable outcome. However, banded around this number you get a range of other possible outcomes, each with a different probability attached.

Probability forecasting is ideal for supply chains that include a high number of long-tail items and face demand variability and uncertainty due to factors like seasonality, new product introductions, weather, Brexit, and other complicating factors.

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Machine Learning for Better Demand Planning

DEMAND INSIGHT INCREASING

	/ Machine Learning Progression	/ How to Apply Data
The Daily Baseline	**1.** Self-adaptive model for probability forecasting Trend, seasonality, calendars, and daily sales patterns	Apply the right technology to "small data" to create a baseline adaptative model for probability forecasting using historical demand history.
	2. Trade Promotion Media Event Effect New Product Introductions	Further improve the baseline probability forecast by applying machine learning technology on existing historical data to get a more robust, reliable baseline that accurately models the phenomena shaping the demand. Incremental data includes historical and future promotions, and media events, but is still largely using demand history, product attributes, and other master data.
Demand Shaping	**3.** External Demand Sensing	Look for additional correlations using external data such as weather, indicators, POS, social media, search, IoT, etc.
	4. Special Actions and Events Market Intelligence	Business user inputs and event modeling

#3. Remember the Four Dimensions of Data: Volume, Granularity, Quality, Variety

Data Volume

The age of big data is upon us and this plays right into the strengths of machine learning. Not only is it important to have the right amount of data to draw upon, but it's equally important to have enough data to derive "statistical significance" from the model.

But what about "small data"? Often the big data isn't as valuable as people would like, and they may not even have it. In the meantime, every business has small data related to historic demand readily available. This small data is the perfect place to begin building a self-learning model that adapts to the nature of demand—and creates an ideal foundation for external causal data when you're ready.

Data Granularity

Machine learning thrives on granularity. Unlike many approaches from the past where data was often aggregated incessantly to weed out noise from the model, it is the examination of that noise and its use to find correlation between it and other seemingly innocuous data elements that help to train the model and give it its power.

Data Quality

You know the saying: garbage in, garbage out. Unfortunately, while machine learning can determine if a specific data stream has a correlative significance, it can't tell if that data is reliable or not. Most purveyors of machine learning implement regimented Data Governance programs to clean, filter and maintain information quality through that data's lifecycle.

Data Variety

Variety of your data is also a key factor. The more different types of data sources you factor in (e.g. promotions, advertising, new product introductions, social media, weather, economic indicators, and others), the more robust and accurate the planning outcomes can be.

Case Example

Improving Promotional Forecasting through Machine Learning

The dairy market is characterized by short shelf-life products and strong promotional pressures. Dairy producer Granarolo runs thousands of promotions annually, producing 34,000 item–promotion forecasting combinations and causing demand peaks up to 30 times baseline sales. This environment requires optimized inventory management and the ability to provide immediate response times.

To manage promotions and correctly estimate peak demand, Granarolo adopted ToolsGroup supply chain planning software, which uses machine learning technology to translate historical data into reliable estimates of future promotions. Using past promotional data, the system automatically generates proposals consistent with promotional peaks. The system proposes dynamic safety stock levels that consider each product class' forecast accuracy and store replenishment frequency so Granarolo can maintain high service levels in the face of changing demand.

GRANAROLO
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Results:

- Forecast reliability increased by 5pp
- Inventory levels reduced by more than 50%
- Reduced delivery time by 50%, minimizing obsolescence

#4. Plan to Operationalize Your Machine Learning Solution

Often businesses will build a machine learning solution to tackle a one-off business challenge, not considering long-term sustainability, or how they will adapt the solution as business challenges change. For sustainable business value you need to operationalize your results for continued success. Here are a few tips to help you prepare:

Choose self-adapting models

To achieve the stability and adaptability required for operational use, it's important to use models that are self-adaptive and do not require continuous tuning by experts, otherwise changing business environments will make them unreliable. This is common with traditional demand planning processes that use multiple forecasting algorithms that are assigned to each item/location according to its demand behavior. The forecast generated by these algorithms degrades as the demand patterns evolve over time. This discrete selection and tuning of the algorithms require human skills that most businesses cannot afford.

A connected solution is key

One-off science projects create "black boxes" that only the developer understands and can support. Business users remain skeptical, and if the developer leaves the company, these models are shelved or discarded altogether. These isolated machine learning projects also require continual manual work to refresh the model when business needs change. The better method uses a self-adaptive model as part of a fully integrated business solution, with models updated automatically on a frequent basis to react to changes in the business.

The system gets smarter over time by factoring in human input and the humans get smarter by learning from the success rate of the forecasts.

#5. Get the Right People on Board to Ensure Success

The automation machine learning brings enables planners to do less manipulating models and spreadsheets and more value-add, strategic work. As your business changes over time, you'll have new questions to answer, and will need to adjust your existing models so that they remain accurate and useful. It's critical to understand the skills and resources you'll need for success before kicking off your project.

Humans + machines—an ideal symbiosis

Part of the strategic work of planners is applying domain knowledge to the process. Machine learning can only do so much; business knowledge and process expertise is required to properly tune machine learning models and evaluate results. This AI-augmented planner role is the ideal symbiosis between human and machines: The system gets smarter over time by factoring in human input and the humans get smarter by learning from the success rate of the probability forecasts. This frees up planners to focus on service, work on strategic projects and add their business insights to the system.

You don't have to do it alone—find a partner

The right machine learning technology partner can help you identify the resources you need, and even provide managed services experts in machine learning and data science to ensure your project is executed properly, and with sustainability and business objectives in mind.

Case Example

Machine Learning Helps Tackle Company Expansion and Demand Complexity

Lennox Residential Heating and Cooling faced the challenge of managing an ambitious North American distribution network enlargement while simultaneously transitioning to a hub-and-spoke model with 55 shipping and 161 selling locations. The company wanted to improve service levels and optimize inventories to reallocate working capital and balance inventory in the changing network. But the supply chain environment was daunting, with a multi-echelon distribution network about to grow by 250%, 450,000 SKU-Locations, many slow movers, and new product introductions.

Lennox implemented a transformational supply chain planning solution to dynamically rationalize the inventory mix and create an operational plan that sets inventory stocking targets and balances service levels with inventory cost. Lennox uses machine learning to reliably model highly variable seasonal demand patterns. It sifts through hundreds of thousands of SKU-Locations to identify "clusters" of those with similar seasonality profiles. These enhanced seasonality clusters substantially increase peak period forecast accuracy.

LENNOX

Results:

- Improved service levels by 16%
- Increased inventory turns by 25%
- Supported significant increases in sales and market share growth

#6. Remember, Machine Learning Isn't a Silver Bullet

Gartner research shows that "three of the top five reasons why organizations haven't adopted AI are related to an inability to articulate a roadmap"[2]. Successfully harnessing machine learning for demand planning is about careful consideration and preparation. Understand that machine learning isn't an immediate solution to every planning problem, but at the same time, don't let fear of the unknown prevent you from reaping the rewards of thoughtful application of this powerful technology.

"Most enterprises will see the greatest benefit from an AI strategy that builds on existing expertise in analytics and incorporates emerging AI technologies"[2].

(2) Gartner--Laying the Foundation for Artificial Intelligence and Machine Learning: A Gartner Trend Insight Report. 20 September 2018 ID: G00373110.

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ToolsGroup has been on the forefront of developing machine learning techniques to solve supply chain planning problems for nearly 10 years. To learn more, visit toolsgroup.com