WHITE PAPER

OPTIMIZE SUPPLY CHAINS WITH AI-BASED DEMAND FORECASTING

Abstract

Supply chains must become flexible and agile to cater to the dynamic needs of today's consumers and keep up with unpredictable market forces. Demand forecasting plays an important role in enabling supply chains to be more efficient at lower cost. However, predicting consumer demand requires capturing the relevant data and understanding it clearly in order to draw insights that enable accurate business decisions. This paper looks at how demand forecasting can benefit from next-gen tools like artificial intelligence and machine learning. It also examines some drivers that are forcing manufacturing organizations to evaluate digital transformation for demand planning models.

Infosys®
Navigate your next

Introduction

Supply chain management in large enterprises has become increasingly complex over the past decade. Companies want to provide personalized products to the end customer and are gathering large volumes of information to enable this. However, many are still limited in their ability to effectively leverage the collected data.

For instance, sales data captures the demand of different product lines over a period of time. But organizations lack a standardized way to structure and use this data to improve supply chain efficiency. Multiple techniques can be employed, right from manual analysis to using various methodologies and tools – the technique we decide will drive demand and the structure of subsequent supply chain.

Emerging information technologies and artificial intelligence (AI) techniques are now being used to improve the accuracy of forecasts and boost the bottom line.

Demand Forecasting

Demand forecasting is the process in which historical sales data is used to develop an estimate of expected customer demand. Demand forecasting enhances sales, supply chain, and marketing operations. It also helps:

a. Meet and satisfy customer demand

b. Set prices and discounts

c. Plan workforce deployment (full-time or part-time)

d. Recycle stock and ensure efficiency

The types of demand forecasting vary and can be influenced by multiple factors such as time span, scope of the market, and level of detailing. It can be economy controlled (based on economic environments, industries, or brands), time controlled (based on long term or short term), passive (using past data), or active (using market research and campaigns).

The various demand forecasting methods that are currently used in various organizations are:

- Econometric (sales data + external factors)
- Trend analysis
- Delphi (using expert opinion)
- Market research
- Focused sales group

To enable demand forecasting using the above processes and methodologies, the main pre-requisite is data. The data may be from internal sources as well as external sources.

Internal Sources	External Sources
Sales data	Social media
Inventory	Internet of Things
Purchase orders	Geological devices
Sales transactions	Household panel data
Loyalty cards	Customer store receipts
Point of sale information	Government census
Reviews	Weather
Marketing campaigns	Third-party data
In-store devices	

With this data in place, organizations need a proper strategy and technology to utilize the data and achieve near-perfect forecasting. Many organizations have a lot of people working as demand planners or forecasters who analyze volumes of data from internal and external sources. But this is time consuming and can be ineffective amidst unpredictable market conditions without the proper tools or approach.

Organizations need to enable digital transformation within demand forecasting through modern platforms and newer application models. These can simulate scenarios, provide better predictive techniques, and bring enhanced data from multiple sources into an AI based tool. This will help make sense of all the data and compute the best estimates.

These non-traditional solutions combine machine learning algorithms with big data and analyze the infinite number of causal factors. Machine learning techniques are designed to learn from the past, improve current performance, and continuously refine and improve the results. However, these are untested waters, and more information is needed to justify their widespread implementation.

Below are some of the factors that are forcing organizations to adopt digital technologies at an accelerating pace:

- The customer is truly king. They are always connected to the marketplace through mobile devices and are fed suggestions through social chatter, thereby influencing purchasing decisions
- Macroeconomic factors like employment and interest rates have a substantial effect on the demand patterns for discretionary spend
- The instant gratification that is available to consumers today has altered expectations. Same day deliveries and product customization have caused demand to be unpredictable while pushing the supply chain to be agile
- Growth of right-wing nationalism and protectionism in several countries is leading to tariff wars, with governments levying unsustainable taxes on imports. There is also a drive for near shoring, if not solely domestic production, to control costs and maintain quality.
- Ubiquitous IoT is seen in everyday life. Refrigerators can monitor snack inventory, check the expiry of food products, and track consumption patterns while virtual AI assistants like Alexa can place an order online to ensure items are re-stocked in time.
- The pandemic has brought the need for digital transformation to the fore. Demand patterns became skewed overnight. For example, while real estate rentals or leasing in urban cities dropped or, at best, remained steady, sports dealers have experienced 1000% increase in sales of jumping ropes and home-gym equipment.

How can artificial intelligence (AI) help resolve some of these problems?

Artificial Intelligence

Artificial intelligence is human-like intelligence demonstrated by machines. It is software that learns, analyzes, and adapts as new data is captured. AI solutions are designed to comprehend complex concepts, solve problems, and arrive at accurate decisions. According to Supply Chain Insights, "CEOs expect supply chain leaders to prepare for digital business and want to know how they intend to develop capabilities and use advanced technologies like artificial intelligence to create a flexible, agile, and responsive digital supply chain."

AI helps in knowledge capture, process automation, and complex decision-making.

AI in Demand Forecasting

AI and demand planning processes are very compatible. Demand planning involves heaps of data to be processed, a step that is repeated in every cycle. A self-learning AI tool can at least match or even exceed a human's planning capabilities in most cases.

Machine learning brings in supervised and unsupervised learning, which helps in supply chain decision-making.

Supervised Learning

- Explicit instructions for making the machine learn
- Expected output data is pre-defined
- Used to predict outcomes
- Can be used to resolve classification and regression problems
- Example: ARIMAX

Unsupervised Learning

- Machine learning based on identifying patterns/structures
- Results will be more qualitative and need to be deciphered
- Outcome is indicative and not a precise value
- Example: Neural networks

Supervised Learning

An Autoregressive Integrated Moving Average with Explanatory Variable (ARIMAX) model can be viewed as a multiple regression model with one or more autoregressive (AR) terms and/or one or more moving average (MA) terms. This method is suitable for forecasting when data is stationary/non-stationary and multivariate (more than one variable) with any type of data pattern, i.e., level, trend, seasonality, or cyclicity.

Unsupervised Learning

A type of this learning is neural networking. This refers to computing systems that are loosely based on the interconnecting neural networks within the human brain. It can be multi-layered with each layer performing diverse transformations based on the inputs. Neural network training is usually performed by calculating the difference between the resultant output of the network (the prediction) and a target output. The difference is seen as an error. The network is then supposed to adjust its weighted associations based on a specified learning rule and looking at this error value. Repeated adjustments cause the neural network to automatically refine its results and produce output that is increasingly closer to the target output.

Comparing the outputs of these two methods with results obtained from traditional methods, such as time series and linear models, assists demand planners in measuring value from AI-based demand forecast processes. Further, ARIMAX techniques are better at predicting outliers for peaks in demand while neural networks generate more "smoothened" and accurate predictions. A hybrid solution can, therefore, yield better forecasts with reduced mean absolute percentage errors (MAPE) and higher forecast accuracy at an overall aggregate level.

In addition to this, AI helps organizations with other capabilities:

a. **Selecting an optimized forecast algorithm:** Algorithm selection with new data addition across every item

b. **Forecast parameter optimization:** Analyze and update forecast planning parameters based on trend, seasonality, and new product launches

c. **Demand outlier adjustment:** Detect inconsistent demand history and subsequent substitution

d. **Unstructured data sensing:** Pattern recognition and natural language processing to achieve correct forecasting

e. **Demand simulation:** Machine learning to derive forecast changes and variations

f. **Automated data cleansing:** Incorrect or inaccurate data needs to be evaluated using machine learning and subsequently cleansed

Benefits

Employing AI-based tools for forecasting provides faster and more accurate forecasts. Deep learning methods overcome the limitations of human cognitive capabilities. These can build rules from huge volumes of data to generate more realistic and complex forecasts. The benefits of using AI for demand forecasting are:

- Demand predictiveness: Companies can accurately predict the types of products that will be picked by customers, thus enhancing customer satisfaction
- Supply chain optimization: AI tools provide forecasts with high confidence levels allowing optimization of supply chain entities. This means products in demand become available while unsold products do not occupy prime retail space. This helps reduce on-hand stock and logistics costs
- Pattern identification: AI can be applied to an organization's historical demand signal in an unbiased manner. AI/ML is expected to self-learn from composite demand patterns combining factors like several seasonality signals, non-linear trends, demand lags and groups the output in suitable buckets to suggest a suitable model
- Causal factors (internal and external): The internal variables include those managed within the organization like product price and analysis, specific promotions, product lifecycles, and data from the point-of-sale. External data relates to the macroeconomic indicators like changes in population patterns, inflation indices like consumer price index, slice of the market share, regional weather information, and consumer sentiment.
- Evaluation of multiple scenarios: Building and analyzing what-if scenarios for precise predictions is what next-generation demand modelling is all about. Organizations can validate multiple cause-and-effect situations at varying sensitivity levels. By accommodating these scenarios as demand models, it allows decision makers to adjust with the changing conditions that are pre-simulated.
- Short-term forecasting: AI is efficient in identifying patterns and solving problems. It delivers insights for short-term forecasting and to predict actual sales orders by checking for data like number of page-views at a granular level. It can also confirm the current inventory positions by pulling data from vendor portals. This is used to recommend optimum inventory levels.
- Supplier relationship management: Predicting customer demand in numbers makes it possible to calculate the product order. Organizations find it easier to determine whether they need to bolster their supply chains or to reduce the number of suppliers. Visibility of the orders and existing capacity helps organizations to negotiate better deals with their vendors since the vendors can afford to be proactive and not rush to fulfil last-minute orders.
- Marketing campaigns: Forecasting is used to draw the market campaigning plan and adjust the advertisements, influencing sales. ML forecasting models can factor marketing data and provide realistic and accurate market forecasting.

Forecasting techniques should vary depending on the product lifecycle to mimic the changes in response to item demand. AI tools are adaptive and can factor these subtle changes while churning out the forecasted data.

Conclusion

Demand forecasting is critical for any supply chain organization. It is driven by many internal and external factors. It involves handling large volumes of data and drawing insights from large datasets, tasks that are formidable for humans. AI-based solutions can cleanse data, define parameters, and develop algorithms to support forecast-based demand planning.

To succeed, a strong foundation of people, processes, relevant data, and optimal solutions needs to be put in place. Further, organizations should leverage advantages of custom-built, industry-leading supply chain technologies to accelerate the adoption and maturity of AI. With AI, demand planners can view supply chain performance comprehensively through a list of KPIs, problems, parameters or levers, etc. They can also check what contingencies are set up to mitigate and minimize impact. AI solutions can recommend changes to mitigate issues along with a closed loop to measure their own performance once the event is past.

About the Authors

Arijit Pramanik
Principal Consultant, Infosys

Arijit works as a Principal Consultant with Infosys. He has over 18 years of IT experience in consulting, project management and pre-sales. His expertise includes Oracle Cloud as well as applications for supply chain management and procurement. He has vast implementation experience with global clients in North America, Europe, and Asia. Arijit acts as a solution anchor in major RFPs and for hi-tech industry solutions where he develops go-to-market strategies for platform-based solutions. He is also a reviewer of tools and accelerators for Oracle Cloud. He is the Product Owner and Anchor for Oracle Cloud's hi-tech solution 'Stratos'. Arijit is also an Oracle Panelist and Presenter for B-school and lateral recruitments. He is a thought leader in the Oracle space, with several white papers published in various forums.

Devesh Arora
Principal Consultant, Infosys

Devesh is a Principal Consultant with Infosys. He is a certified cloud professional with more than 15 years of experience in the IT industry as a consultant for Oracle applications. His focus is on Oracle solutions around procure-to-plan and plan-to-produce business cycles where he handles implementation and upgrades. He has executed transformation programs for clients in engineering, retail, hi-tech, and aviation across multiple countries in EMEA and APAC as well as in the USA.

For more information, contact askus@infosys.com

Infosys®
Navigate your next