

A Descriptive Study on Artificial Intelligence and Block Chain to Improve Demand Accuracy, Inventory and Customer Fulfillment Levels with Special Reference to CPR (Consumer Products & Retail) Industry

Vibhore Khandelwal

Manager, Department of Supply Chain Management, Hafele India Pvt. Limited Mumbai, India

Abstract: Era 20-20 is an esplanade for Industry 5.0. Real time analytics, artificial intelligence, block chain and virtual transactions combine to automate and orchestrate large areas of retail, manufacturing, hi-tech, CPG, Logistics etc. linking wired and wireless networks throughout the world in the making of products, and relying on both structured and unstructured big data to get the job done. In the world of transformation and digitalization, it's not all about products but rather intelligent automation and cognitive agents/players plays a significant role in streamlining the services as well. Integrating industry 5.0 technologies and lean methods make supply and demand planning more efficient, more automated, faster, more reliable and smarter. This development offers enormous optimization potential with regard to process quality, flexibility and planning costs.

As the number of sales and fulfillment channels increases, operations become increasingly complex and more variable. Amidst this increasing complexity, it is imperative for retailers, manufacturers and service providers to find ways of reducing costs, especially in the big cost areas of inventory, labour and waste, to stay profitable. Accurate forecasting is at the core of increased operational efficiency as it is key to accurately match resources, such as stock and personnel, with demand. Demand Sensing allows organizations to incorporate detailed short-term and vulnerable demand data into their forecasts to reduce their forecast error by up to 40-50%, thereby increase inventory accuracy by up to 20-30%, and optimally deploy available inventory whether it's in transit, shipped from the warehouse, cross docked, flowed through or shipped direct from the manufacturer. This paper focuses on how organizations that use demand sensing are able to receive the best forecast for response and execution time horizons. Also, gives an overview that how a demand sensing solution helps in inventory optimization, increase inventory turns and reducing inventory holding. Augmented Reality (AR) coupled with Artificial Intelligence (AI) will create that step change improvement. Right from sensing the demand from market, having the stock in warehouse till articles dispatched to customer, augmented reality enables the process owners to manage and govern end to end inventory management.

Keywords: Demand Management, Demand Sensing, Order management, Demand driven deployment, Block chain, Artificial intelligence, augmented reality.

1. Introduction

High variability, fast-moving trends and fluctuations in consumer behavior make it critical to track demand closely. Traditional demand planning techniques were developed decades ago when distribution channels were few, market is not that volatile and aggressive and history was a relevant predictor of future events. Today this method is not viable, and there are a number of hindrances to predicting near-term demand:

- Promotions and marketing programs designed to shape consumer behavior and change buying patterns
- Volatility driven by changes in consumer preferences and social sentiment
- Growth-through-innovation strategies and rapid stock keeping unit (SKU) proliferation
- Omni-channel and e-commerce strategies that disrupt traditional distribution and make historical orders even less relevant to future demand

Evolving customer behavior and rising market volatility have underscored the opportunity to sense and react in near real-time to changes to changes in the demand supply network. Yet these shifts have also exposed the limitations to traditional forecasting techniques and hence give rise to disruption in complete sales and operational planning. Not only the process but technology these days plays a significant role in sensing the market, measure the fluctuations and translating it in more near demand.

2. Concerns/Challenges/Discussion & Focus areas

Following are the challenges which most of the organization face while doing demand management,

- *Traditional Statistical forecasts* are based on historical data. Therefore, they are not that sufficiently representative of various casual factors that influence demand going forward. We can just analyze patterns and create baseline forecasts.
- *Business actions* that impact demand are not always

collaborated within the organization, creating a lack of visibility within the company.

- New product introductions
- Demand generation initiatives & Cannibalization
- Siloes departmental working sometimes come as a surprise to demand planners
- Price changes
- Customized solution to various customers
- Companies are slow to develop digitalization. Therefore, S&OP processes remain fragmented. This results in time delays, unmatched supply-demand, and excess or insufficient inventories.
- Data management and analytics are mostly restricted to ‘offline work’ and are not integrated within the sales forecasting process. ‘Descriptive analytics’ with its product attribute-based assessment, is one level of information. ‘Predictive analytics’ using more complex algorithms to better predict outcomes, is rarely integrated. Nor is ‘prescriptive analytics’ to provide suggested corrective action.
- The demand generation initiatives impact buying significantly but are not evaluated properly in the short-term cycles. Actions such as new products, flash sales, mark-downs, BOGO (Buy one – Get one) deals, volume discounts, advertising, and information on social media can influence SKU-level sales almost immediately. This phenomenon contrasts with traditional forecasting plans and methods that project macro demand over 30 to 90 day cycles.

3. Approach to address challenges and making demand planning smarter and agile

Two critical problems occur when procurement and demand are not balanced, they are as follows:

- Income/profit loss and decreasing customer satisfaction due to stock outs
- Increasing inventory costs and decreasing profitability as a result of launching promotions to decrease inventory due to overproduction

Keeping the above mentioned challenges and problems in mind, following is the basis and pragmatic approach to decide on how to define the demand forecasting process and resonating into next gen demand sensing approach enabled by artificial intelligence.

Basis for deciding the approach: Artificial Intelligence & Machine Learning for better demand planning.

The below evolution from traditional to neural methodology for demand management helps in defining the approach – 3‘E’ approach of demand sensing.

Engage

- Gather data from all relevant sources
- Conduct monthly S&OP meeting with cross functional teams
- Monthly forecast update on aggregated level

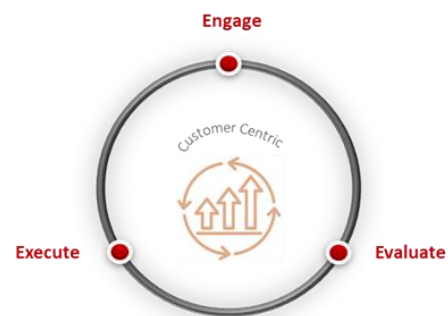
Evaluate

- Analysis of data and supply & demand alignment
- Take buy-in from cross functional teams contributing directly in demand management

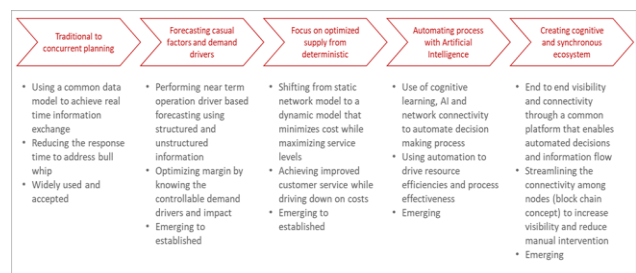
Execute

- Finalize the plan on monthly basis
- Start pushing PO’s to suppliers
- Regular review of inventory at various stages

	Artificial Intelligence / Machine Learning	Data applicability
Demand Alignment	<ul style="list-style-type: none"> • External demand sensing • Market Intelligence 	<ul style="list-style-type: none"> • Look for additional data correlations such as external and internal factors e.g. Discounts, season etc. • Business user inputs and modeling based on special events
The Daily Baseline	<ul style="list-style-type: none"> • Self – adopted model for probability forecasting • Historical data – Trends, seasonality , calendars and daily sales patterns • Trade promotion • Discounts & Schemes • New Product Introductions • Media event effects 	<ul style="list-style-type: none"> • Adaptive model to cater data for probability forecasting using historical demand data • Further improve the baseline probability forecast by applying machine learning and artificial intelligence on existing historical data to get more robust and reliable baseline that accurately models the phenomena shaping the demand. • Incremental data for promotions largely used demand history, product attributes and other master data



4. The evolution (paradigm shift) from sequential to more synchronous and collaborative planning



5. Different forecasting models that are applicable to different types of data due to different tradeoffs

While the increased complexity of AI/ML models can yield more accurate demand forecasts in some cases, tradeoffs in the difficulty of implementation mean that the nuances of the products determine which model will yield the best results for you.

Weighing the pros and cons of each model outlined above are a start, but the product set might not neatly fit into a single model type. To work around this limitation, it’s also possible to build an ensemble model, which takes models from multiple different classes and averages across them. This approach has

Table 1

Models	Example Methods	Pros	Cons
Historical Average	Simple Moving averages, Exponential Smoothing	Simple & can be implemented anywhere	Without regressors, the prediction can be slow to react to changes in demand or be over response to outliers
Time series	Seasonal ARIMAX, Generalized additive model	Well accepted method with consistent variation. Can consider multiple and complex time stamp variations along with other drivers	Expects particular seasonal or time dependent structures, limited history requires too much assumptions
Machine Learning & Artificial Intelligence	Gradient boosted machines, Neural networks, Support vector machine and block chain	Nonlinear and complex relationships can be discovered without a need to pre select the model type or make assumptions regarding external factors	Requires a lot of data and initial investment in set up, may require parameter tuning and regular learning of machine to respond to scenarios.

the benefit of incorporating effects generated from each of methodology; similar effects are strengthened, while inconsistent effects are canceled out.

6. Create a custom deep learning (artificial intelligence) model for efficient forecasting



Machine learning is not programmed, but taught with data

Sample Outputs



7. Five critical success factors - key enablers to a demand-driven supply chain

1. Demand signal capable of driving effective, efficient anticipatory decisions.
2. Collaboration, integration, synchronization across supply chain functions
3. Creation of a perpetual learning function
4. Advanced data analytics capable of multivariable,

multi-equation optimization

5. Unbending dedication to Total Value Optimization™ (TVO)

8. Conclusion

Accurate sales & demand forecast plays pivotal role in all the planning systems of any business type. Poor forecast accuracy results in making wrong assumption and leads to wrong decisions. It has proven that higher accuracy can be achieved with right data preparation from many studies. Data preparation process takes 80% of the time of any analytics project because we must make sure proper data fed into the model otherwise it is like “Garbage in and Garbage out”.

There has been a growing momentum across multiple industries to move from a "one-size-fits-all" approach to a portfolio of different supply chain strategies. Companies segment Supply Chains using different attributes across multiple dimensions of product [product volume or demand variability], customer [Customer/Channel value] to design multiple efficient or responsive Supply Chains

Certain benefits of moving from traditional demand management approach to cognitive demand sensing approach,

- Drives forecast accuracy from the traditional 60% to over 90% at the article/bin/location level.
- Reduces inventory requirements, warehouse and logistics costs.
- Scales to process the high volumes of data associated with hundreds of thousands of item and location combinations.
- Enables ability to replenish the high frequency demand signals with optimized execution.
- 100% visibility across all nodes in the demand block chain.
- Real time demand sensing and analysis.
- To reduce forecast error by up to ~50%.
- Increase inventory accuracy by up to ~20%.
- Improved service levels by 16% - 20%.
- Increased inventory turns by 25% - 30%.
- Supported significant increases in sales and market share growth.

To improve demand management process, organization must focus on the followings,

- Increase collaborative efforts across the entire

- organization.
- Embed artificial intelligence into sales & operations planning.
 - Capture more detailed, segmented and more granular product data.
 - Implement a unique set of event based data around. For e.g. External & internal factors.
 - Opt for appropriate technologies to automate and streamline forecasting workflows.
 - Integrate downstream consumer demand information into the plan specifically (visibility across all players in supply chain).
 - Run statistical analysis and discuss on outcome with all permutations and combinations.

- Make consensus on the result and designate a domain expert to drive and facilitate the decisions further.

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