
CONTENTS

01

EXECUTIVE SUMMARY

02

WHAT IS DEMAND FORECASTING

03

WHY DEMAND FORECASTING
MATTERS

04

PRESSURES AND CHALLENGES

05

THE RIGHT WAY TO FORECAST

06

YOUR ACTIONS



EXECUTIVE SUMMARY

Faster pace of new product introductions and the unavoidable long tail phenomenon where an exponentially large number of products contribute to a less than 20% of the revenue, has caused significant challenges to traditional demand forecasting methods.

The executive needs to understand the challenges caused by large scale item proliferation, the resulting impact on the ability to forecast, and the potential solutions.

Traditional Demand Forecasting approaches and tools are not equipped to address these challenges. The fact that industry-wide forecast accuracy scores stayed flat over the past 5 years confirms that traditional approaches have not kept pace with the changing landscape.

Not getting right tool set and processes to support the complex landscape is causing significant operational and financial impact – More inventory, obsolete inventory, lost sales opportunities and impact on customer service levels.

A new set of Artificial Intelligence driven approaches show promise, with their ability to predict the demand based on large number of variables, algorithms that can self-tune, self-learn and address many of the underlying challenges.



WHAT IS DEMAND FORECASTING?

Demand forecasting is about estimating the future demand for the products you sell. You could be selling hundreds or thousands of products, and demand forecasting estimates how much quantities you are expected to sell.

Companies forecast at various levels: Some do at lowest level for each Product Stock Keeping Unit (SKU), some do at a Product level, while other do at a higher level of aggregation such as Product Group, Product Category, or even at a Product Line level.



WHY DEMAND FORECASTING MATTERS?

For organizations with a large number of fast selling SKUs, getting demand forecasting right is a key source of competitive advantage.

Organizations that have reliable demand forecasts have leaner inventories, better inventory turns, and more cash available to meet the surges in the demand.

Organizations that don't do forecasting well, tend to suffer from excess inventories, obsolete inventory, more working capital tied up in the inventory.



PAY-OFF WHEN DEMAND FORECASTING DONE RIGHT -

The Best-in-Class leaders has an average forecast accuracy of 85% and above at the product family level. Other key improvements, according to Purdue University-SAS study are:

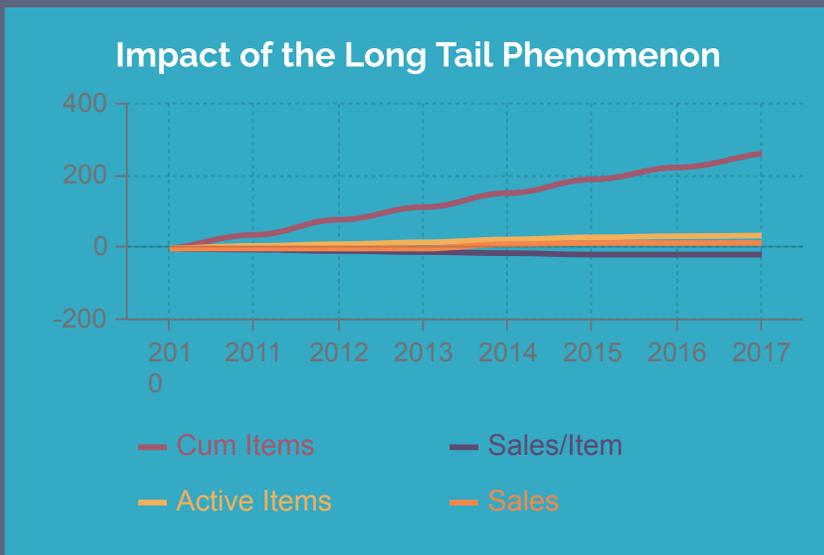
- Five times improvement in inventory turns.
 - 3 times improvement in order fulfillment rate.
 - Two times improvement in overall performance compared to competitors.
 - 7 times improvement in gross profit margin
-

WHY DEMAND FORECASTING IS HARD

Some businesses enjoy a stable pattern of demand that is predictable. They may be in a mature industry. Or they could enjoy long customer lead times such as those in the Engineered-to-Order, or Made-to-Order manufacturing models. Others may experience a significant impact because of competition and other challenges from the external environment. Ultimately it boils down to 5 principal reasons.

- New Product Introductions - Inability to forecast and understand the impact on the existing products.
- Wild patterns of demand.
- Mergers and acquisitions that introduce competing products, with unknown risk of cannibalization.
- Inability to forecast at the SKU level.
- Lack of focus on the demand forecasting.

REASON 1: NEW PRODUCT INTRODUCTIONS - THE INNOVATION CONUNDRUM



Source: E2OPEN Benchmark Study-2018

The “Long Tail” phenomenon pioneered by Amazon with endless virtual aisles has become standard expectation and strategy for all other players. In response to the competition, companies are trying to innovate hard, and the rate of innovation is accelerating.

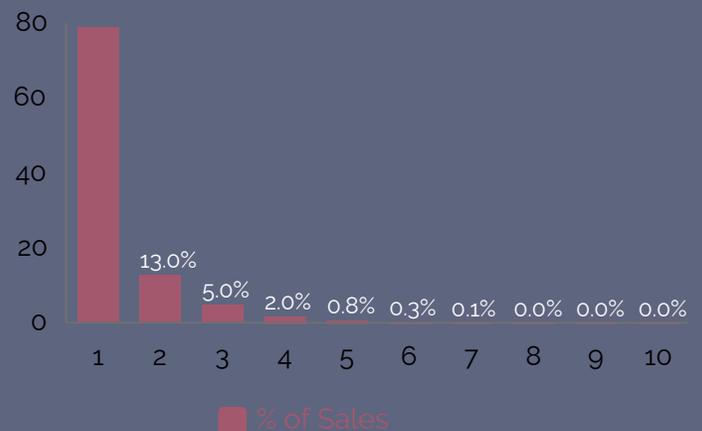
Total number of items is 7 times the active items, and the sales/item is going down.

Source: E2OPEN Benchmark Study-2018

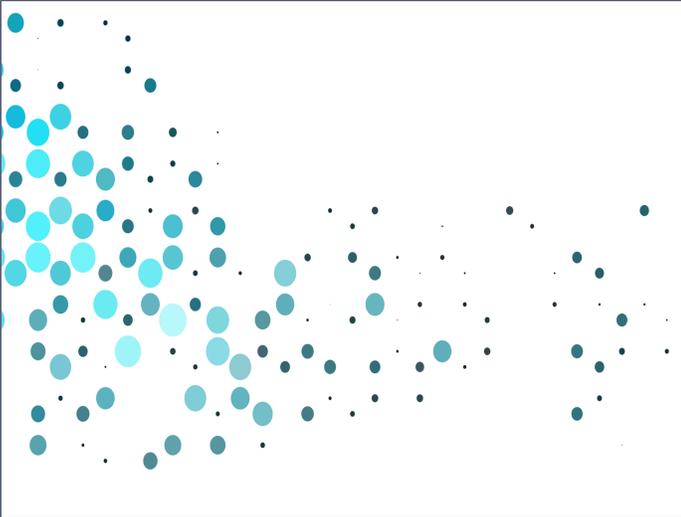
The less understood aspect of this innovation boom is the challenge it brings to the forecasting. New products are hard to forecast; they will not have a lot of sales to build the forecasting models. This in turn leads to bigger forecast errors and has negative impact on financial and operational performance.

The cost of managing an exponentially large number of items becomes challenging and expensive without the right forecasting tool kit.

Item Distribution Across Deciles



WILD PATTERNS OF DEMAND



Businesses that are highly susceptible to seasonal, cyclical, external and macro-level events are harder to forecast.

- Unexpected supply shocks - War in the Middle East, Tsunami in Japan, Hurricane disruptions
- Trade wars and tariffs
- Customers going out of business
- Rapid technology changes, particularly in consumer product categories
- Swift changes in consumer preferences, particularly for fast fashion, home goods, etc.

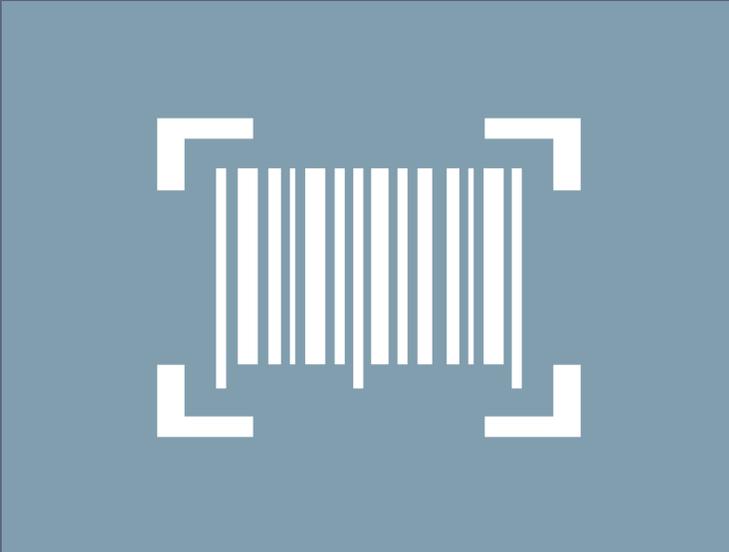
MERGERS AND ACQUISITIONS

When companies acquire other companies or merge, there is an immediate impact on the demand forecast that is hard to quantify. Some factors will affect positively, while others negatively. But overall the unique circumstances surrounding an acquisition make the demand forecasting process extremely hazardous.

- Similar products may cannibalize the sales
- Loss of key sales Personnel could have a negative impact, including loss of customers
- New demand because of the cross-sell and up-sell opportunities
- Lack of historical data in some cases.
- Closure of facilities impacts the demand
- Other decisions to drive synergies will impact demand.



NOT ABLE TO FORECAST AT THE SKU LEVEL



Many businesses forecast at some level of aggregation such as Product Group or Product Category and then allocate to the SKU level. Class-leading companies forecast at the SKU level. Not forecasting at SKU level leads to assumptions and approximations on product mix and supply requirements.

- Products cannot be substituted as freely as the salespeople would like to think.
- Colors and finishing options seem swappable, but need to have nuanced understanding.

LACK OF FOCUS ON DEMAND FORECASTING

Many organizations lack the Demand Forecasting function altogether. Some organizations create annual plans. Few others just create forecasts by simply increasing prior period numbers by a fixed percentage.

Understanding the importance of the Demand Forecasting function is the critical first step for any organization. Right prioritization and investments in the people, process, methodology, and tools will follow.



HOW TO GET BETTER AT FORECASTING

Step 1: Establish Forecastability



Recognize that not all items can be forecasted with the same level of accuracy. A high degree of accuracy can be achieved easily for long-running, stable demand items.

Conversely, for organizations with products that have short life cycles, a high rate of new product introductions, rapidly changing consumer preferences and technology changes, forecasting is harder.

More sophisticated methods, machine learning models and Data Science methodology is required to forecast New Product Introductions (NPIs), particularly in new product categories.

Forecastability is measured based on accuracy in a naïve forecast. The naïve forecast is a simplistic forecast based on a seasonally adjusted moving average, and the accuracy of this forecast is a measure of forecastability. A business with a lower naïve forecast error is more forecastable than one with a higher naïve error. Companies on average have a naïve forecast error of 35% (Source: 2018 study by E2OPEN)

KEY TAKEAWAY

Establishing Forecastability is the critical first step.

Forecastability has nothing to do with the skill or methods used for forecasting. Rather it reflects product types, volatility, and pace of new product introduction (NPI).

HOW TO GET BETTER AT FORECASTING

Step 2: Measure Forecast Error

There are 2 common methods to measure the forecast error. The Mean Absolute Percent Error (MAPE) and the Weighted Average Percent Error (WAPE)

MAPE for a single period = $(\text{Actual Demand} - \text{Forecasted Demand}) * 100 / \text{Actual Demand}$



An average of forecast errors computed over multiple periods will give a Mean Absolute Percent Error (MAPE) over time.

When computed over multiple periods, MAPE averages the forecast error and does not consider the underlying quantities. So a 30% MAPE could be based on 10 units or 10 thousand units.

Weighted Average Percent Error, on the other hand, factors in the underlying quantities. When computed over multiple periods, WAPE reflects the impact of varying quantities across the periods and is more reflective of the impact of poor forecasts.

KEY TAKEAWAY

Weighted Average Percent Error (WAPE) is a better metric of forecast accuracy.

HOW TO GET BETTER AT FORECASTING

Step 3: Measure the Forecast Value-Add (FVA)

Forecast Value Add is the quantum of improvement in the Forecast Accuracy compared to the Naive forecast error. In other words, it is a reflection of how much you were able to improve from the base level of forecastability.

Forecast Value-Add is the difference between Naïve Forecast Error and Final Forecast Error. It represents the quantum of improvement made and the value added by good forecasting process. As shown in the table below, company A has more FVA at 15%, even though it has higher amount of WAPE.



Company A:
Naive Error: 50%
WAPE: 35%
FVA : 15%

Company B:
Naive Error: 40%
WAPE: 30%
FVA : 10%

Forecast Value-Add allows a comparison of the effectiveness of the forecasting process among multiple business units. You could establish naive forecast measures at the product category level, and establish FVA at a product category level. This allows you to pinpoint the products that are harder to forecast and focus more on those.

KEY TAKEAWAY

MAPE and WAPE do not allow comparing the performance.

Forecast Value Add (FVA) tell you the quantum of the improvements you made in forecasting and allows an apple - apple comparison.

HOW TO GET BETTER AT FORECASTING

Step 4: Measure Forecast Bias

Forecast bias represents the tendency of the organization to be consistently over forecasting or under forecasting.

A positive bias means, often, the forecast is more than actual. It reflects the organization that is consistently overly optimistic.

Conversely, a negative bias represents a forecast that is oftentimes less than actual.



A forecast bias of more than 5% either positive or negative could mean a significant impact on the operational metrics.

KEY TAKEAWAY

Measuring forecast bias will tell you whether the organization is overly optimistic or pessimistic.

HOW TO GET BETTER AT FORECASTING

Step 5: Understand What Drives Demand

Once you understand your current metrics, the next set of steps are oriented towards improving the Forecast Value Add and Forecast Accuracy. The first step towards improving these metrics is to understand what drives the demand. Some of the factors that impact demand are internal while others are external. You may be able to control any of the internal factors, but for external factors, you can only plan around those.

- **Your Marketing spends:** The products and channels that you are investing your marketing dollars has direct impact on the sales.
- **Customer Forecasts:** If you are engaged in collaborative forecasting, your customers provide their forecasts.
- **Competition:** The strength of your competition has direct impact on the demand of your products.
- **Macroeconomic factors:** Categories such as luxury products are more sensitive to the economy.
- **Seasonality and Business Cycles:** Regional Holidays, seasons, weekends have impact on demand.
- **Sales Incentives:** The allowances and subsidies that you are planning to give to your customers and channel partners impacts the demand.
- **Pricing:** Changes in the pricing strategy have the most direct impact on the demand.
- **Promotion strategy:** New promotions, changes in the promotion mix.
- **New Products Introduction:** There will be a level of cannibalization effect on the sales of existing products.
- **Unavailability of products:** If you don't have enough inventory or expect supply shocks, that reduces the demand forecast.

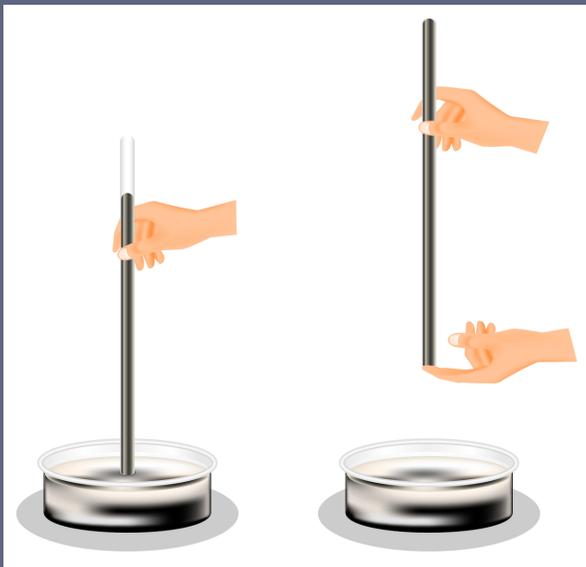
KEY TAKEAWAY

Demand is dependent on a large number of internal and external factors.

HOW TO GET BETTER AT FORECASTING

Step 6: Forecast at the right level

A lot of businesses forecast at an aggregate level such as Product Category, instead of forecasting at the individual product level that is purchased.



In many cases, there are technological and organizational constraints, but forecasting at an aggregated level causes 2 types of issues.

- Supply planning is significantly less effective. When the forecast is at a higher level of aggregation it is imprecise at an individual product level, and you are already starting with a disadvantage.
- Your financial forecasts are less reliable since the estimates are made at an aggregate level.

Key Takeaway

Forecasting at the aggregate level leads to ineffective supply chain planning.

HOW TO GET BETTER AT FORECASTING

Step 7: Recognize that your product mix has products with different demand characteristics.



Organizations will have products that exhibit a combination of the characteristics outlined below.

- Products with stable demand
- Products with large fluctuations and variations in demand
- Products that have short life cycle
- New products in a new category, with no history to go by
- Products with intermittent demand

Instead of recognizing and being strategic based on the product mix they have, we see many organizations taking a formulaic approach to demand forecasting. This typically means forecasting an increase such as 5% over last year's sales. Then the supply chain is planned around it. This could lead to a lot of waste or lost opportunities, but at times can land a catastrophic blow to the health of the business.

KEY TAKEAWAY

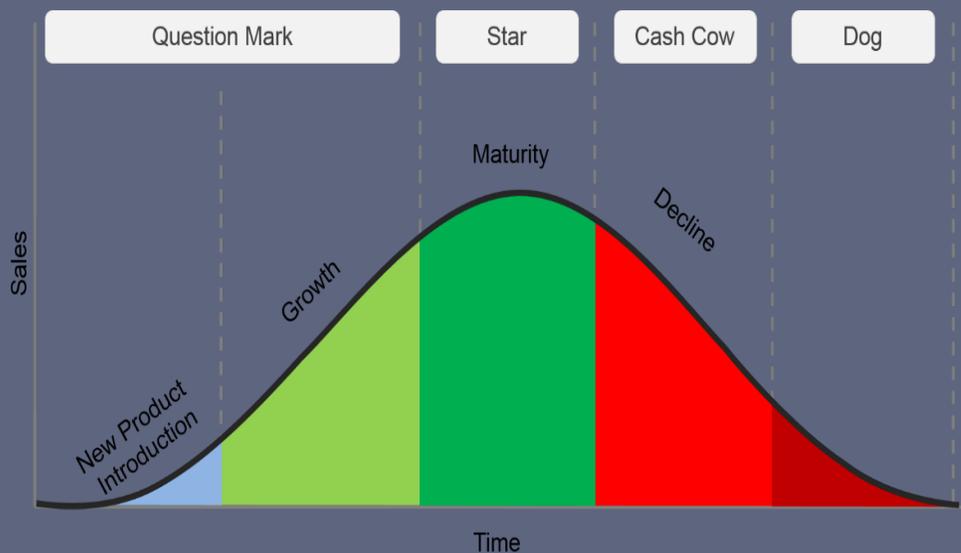
Organizations always have a mix of products with varying characteristics. The temptation to apply a uniform rate of growth should be resisted.

HOW TO GET BETTER AT FORECASTING

Step 8: Recognize that every product has its own life cycle

All products go through 4 distinct stages – Introduction, Growth, Maturity and Decline.

Being able to spot whether product is in Growth or Decline is critical for businesses. In many cases, the signs are not obvious. This inability to recognize the patterns and forecast accurately causes lot of wasted opportunities or excess inventories.



KEY TAKEAWAY

Every product goes through several life cycle stages. Forecasting methods differ for each of those stages.

HOW TO GET BETTER AT FORECASTING

Step 9: Recognize the limitations of the tools you have

There are several forecasting methods that handle certain types of patterns. Some methods are good for products exhibiting stable demand, while others do well in forecasting for products that have intermittent demand.

It is worth remembering that each of the methods works well only under certain conditions. As products move through their life cycle stage from introduction to decline, methods that were appropriate at one time, will not yield the same level of accuracy.



Some of the popular forecasting models

- Random Walk – Uses latest actual sales to project the future demand. Good for small number of products to be forecasted
- Multiple Regression – Correlates multiple factors such as holidays, and projects future demand. Works well for high volume of products with stable demand.
- ARIMA and ARIMAX – Correlates based on past sales data and projects future forecast. Dynamic Linear Model – This forecasting method handles the dynamic changes in the demand patterns well.
- Exponential Smoothing – Analyzes trends and projects future demand

KEY TAKEAWAY

There are several statistical forecasting methods available, but each works well only under specific circumstances.

HOW TO GET BETTER AT FORECASTING

Step 10: Use Machine Learning models that are purpose-fit

No two businesses are alike. Further, each SKU goes through its own life cycle. Considering these, no single forecasting model will give the best possible accuracy. A purpose-fit collection of Machine Learning algorithms, configured to fit the profile of the products being forecasted, would be required.



Traditional and machine learning techniques differ in their capabilities and requirements. Traditional time series and regression techniques normally consider either a single or a few variables such as trend, seasonality and cycle. Machine learning-based techniques can process an unlimited number of predictor variables, determining the ones that are significant.

The data source for traditional demand forecasting is mainly from demand history, while machine learning-based techniques can make use of limitless data sources.

Machine Learning models differ qualitatively from statistical models that are more often used in the industry. Machine Learning models learn a great deal from history, detect patterns that are not obvious, and predict the demand with great accuracy.

Machine Learning models learn and get more accurate with usage. As the actual data gets in, and the surrounding external environment is captured to the extent possible, the machine gets further intelligent by understanding what has caused the variance from the predicted demand.

KEY TAKEAWAY

Machine Learning models are most accurate because of the ability to understand and interpret all the reasons surrounding the history and forecast better.

Key Takeaways recap

- Establishing Forecastability is the critical first step. Forecastability has nothing to do with the skill or methods used for forecasting. Rather it reflects product types, volatility, and pace of new product introduction (NPI).
 - **Weighted Average Percent Error (WAPE)** is a better metric than **Mean Absolute Percentage Error (MAPE)** of forecast accuracy.
 - MAPE and WAPE do not allow comparing the performance. Forecast Value Add (FVA) would tell you the quantum of the improvements you made in forecasting and allows an like - like comparison.
 - Measuring forecast bias will tell you whether the organization is overly optimistic or pessimistic.
 - Demand is dependent on a large number of internal and external factors.
 - Forecasting at the aggregate level leads to ineffective supply chain planning.
 - Organizations always have a mix of products with varying characteristics. The temptation to apply a uniform rate of growth should be resisted.
 - There are several statistical forecasting methods available, but each works well only under specific circumstances.
 - Machine Learning models are most accurate because of the ability to understand and interpret all the reasons surrounding the history and forecast better.
-

Authors' bios



Co-founder and Executive
Client Partner

Suresh is a Certified Supply Chain (CPIM from APICS) expert with more than 2 decades of experience in Operational consulting and IT leadership roles across Manufacturing, distribution, retail, logistics, market research and E-Commerce.

Suresh is an MBA and a CFA charter holder.

[Connect on LinkedIn](#)

Veda built VectorScient's high performing Prediction Engine from ground up. Prior to VectorScient, Veda led complex projects in Demand Forecasting and Predictions, Price Elasticity, Advanced Supply Chain Planning.

Veda has bachelors degree in statistics and masters degree in Computer Applications.



Co-founder, CEO
Chief Data Scientist

[Connect on LinkedIn](#)