



Demand Forecasting For CPG/Retail

OVERVIEW:

Clairvoyant, in collaboration with the University of British Columbia, implemented a demand forecasting solution with Location-Based Intelligence models for Rich's foods. Rich's foods is one of the world's largest family-owned companies, with over \$4 billion in revenue. Clairvoyant's solution carried the ability to accurately forecast the client's demand for a wide range of products.

MAJOR WINS:



Forecast accuracy for overall demand went up by 25% & above 80% for the Top SKUs



The forecast accuracy for the hierarchical demand for the top SKUs reached 70%



Highly scalable solution. The models can be built in under 8 hours for ongoing predictions

ABOUT RICH'S FOODS

Rich Products (Rich's) is a global food manufacturing company, focused on bringing innovative value to its consumers and customers worldwide. Rich's has over 25 US/Canada plants supporting over 90M cases of product to over 3,500 customers annually. Rich's serves customers ranging from major and minor grocery stores, chain and local restaurants, schools and universities, cafeterias, and convenience stores.

BUSINESS CHALLENGES:

The client approached Clairvoyant with an existing legacy system that forecasts the overall demand with a 60% accuracy rate before the pandemic and at an even poorer rate during the pandemic.

They were looking to upgrade and modernize their infrastructure. We operationalized an end-to-end AI mechanism that could generate an accuracy rate of approximately 80-90%, keeping the "new normal" in view.

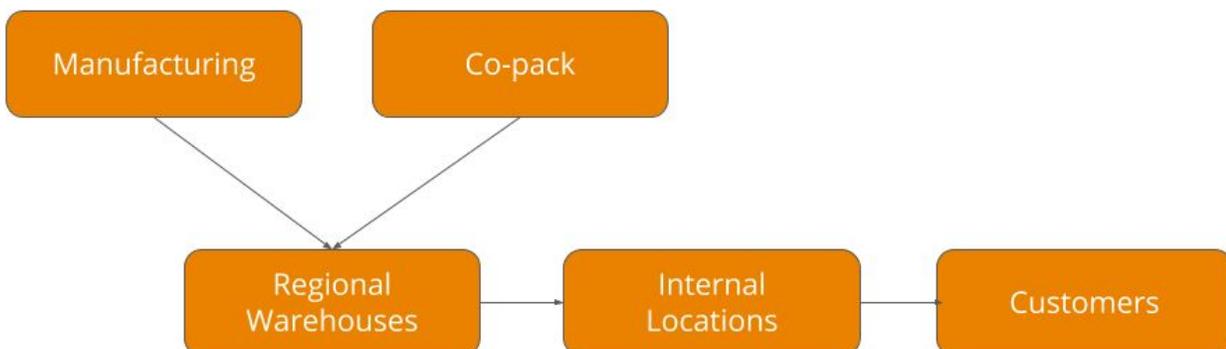
They also wanted an intelligent system to forecast a granular demand for their SKUs and top customers.

THE PROBLEM STORY:

A supply chain challenge coupled with the unprecedented effects of the pandemic

Understanding the Rich's Foods Supply chain

Rich's has 4 main manufacturing facilities and 25+ co-packing locations for additional capacity and new products throughout the US. Rich's supplies over 90M cases of product to over 3,500 customers annually. Through R&D innovation and acquisition, Rich's has expanded its purview from non-dairy whipped topping to include donuts, cookies, cakes, pizzas, ice cream cakes, appetizers, and much more. It serves customers ranging from major and minor grocery stores, chain and local restaurants, schools and universities, cafeterias, and convenience stores. With its wide variety of product offerings, Rich's uses a regional warehouse consolidation model to combine products from several manufacturing plants and service multiple product types.



PROBLEM STATEMENT IN DETAIL:

- Rich's current system's forecast is majorly compiled at a high level/warehouse level, and not the customer level. For the Network Modeling & Design team to model scenarios such as risk simulation for potential macroeconomic events, consolidation of manufacturing locations, or warehouses, they need more granular data.
- With the advent of the Coronavirus Pandemic and the drastic change in consumer behavior, all forecast accuracy has declined significantly.
- Equip Network team with Location Intelligence/Context to model additional scenarios like transportation lane optimizations and accurately project results to stakeholders.

THE PREMISE:

Understanding Demand Forecasting

Demand Forecast Practices

The traditional “inside-out” demand forecasting process is long gone. Companies are now adopting the “outside-in” approach to achieve a more real-time, consumer-centric process that relies on how much the customer wants to consume rather than how much the company can produce. The modern demand forecasting process follows the below:

- a wide array of parameters are considered to capture the volatility and complexity of the outside world and arrive at real-time forecast figures.
- it features granular level data collected from customers, retailers, cross-functional teams, etc. to widen the source of input data and increase the forecast's accuracy.

Demand Forecast Challenges

Every company strives to achieve the highest accuracy possible with its demand forecast figures to avoid any aberrations in the supply chain process. But, the unprecedented pandemic has greatly impacted even the best laid-out demand forecasting workflows.

CPG firms are struggling to optimize fill rates on retail shelves and manage the government imposed restrictions on purchase. The pandemic-induced panic buying has resulted in a sharp increase in the slow-moving stocks of value-priced store brands. Stock-outs have become a common phenomenon, given a shift in the consumers' focus from quality and price to accessibility and availability.

THE SOLUTION STORY

Solving the Forecasting Challenge

Since our first interaction with the client, we promised complete ownership of turning the demand forecasting mechanism around. Our exceptional data engineering and operationalizing AI skillset, coupled with our drive to build scalable and user-friendly solutions, enabled us to produce a POC in just 2 months.

The Approach

In just about two months, our team challenged itself to accomplish the following:

- understand the impact of the COVID pandemic on Rich's products
- identify the public datasets that can be used to model consumer behavior
- ingest the public datasets
- pre-process and aggregate them to a standard dimension in Rich's data,
- and merge them with Rich's Orders transactions

The public datasets used to model consumer behavior for Location Intelligence include:

- US Geographic Information Systems (GIS) Data
- Demographics
- Socio-economic data
- Consumer Price Index
- Personal Consumption Expenditure
- Disaster Data that considers COVID but can be extended to other natural disasters listed by FEMA

From close to 600 attributes relevant to Rich's products and consumers, we have identified approximately 150 of them for feature engineering.

Clairvoyant's Databrew - a True AutoML platform with Deep Feature Synthesis for auto feature engineering; segmentation, feature selection, Auto ML, and hyper-parameter tuning is used for training with multiple algorithms and selecting the best performing model for the data.

Prophet time-series forecasting and XGBoost regression models have proven to be the best performing models for clustered modeling and hierarchical modeling approaches mentioned below.

The Data At Hand

Phase 1 Granularity - SKU	
Number of SKUs	500
Forecast Delivery	Weekly Forecast for the next two weeks
Machine Learning Model Type	Time-series Forecasting

Phase 2 Granularity - (SKU x State x Top N Customers + SKU x ZIP Code)	
Number of SKUs	500
Number of Customers	3700
Number of Zip Codes	41000
Forecast Delivery	Weekly Forecast
Machine Learning Model Type	Regression

Clustered Modelling

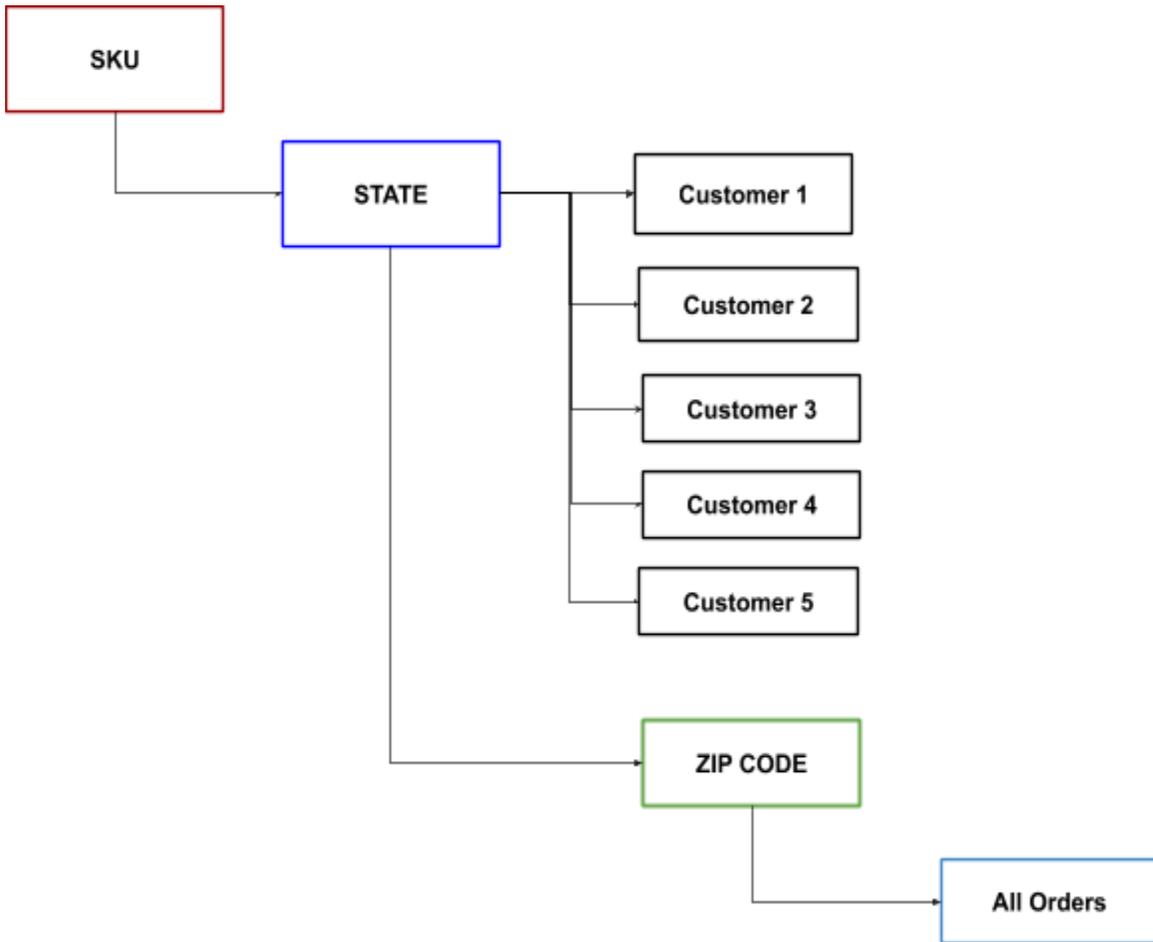
Materials, based on their seasonality, trend, and changepoints, have been clustered together and a one-time series forecasting model per cluster has been created. These models will automatically recalibrate themselves with more data in case of unanticipated events, such as COVID or microeconomic factors that can influence consumer behavior.

Hierarchical Modeling

After observing the geographical distribution of the orders for many SKUs from various customers, we have defined a hierarchical structure to predict the demand at the most granular level possible - the customer.

XGB Regressor model is built using customer orders data and the features engineered from the public datasets to predict the demand at the customer level for the top 5 customers in each state and the rest of the orders rolled up to a zip code level for each SKU.

Hierarchical Structure



THE RESULT STORY

Clairvoyant successfully built the Forecasting and Regressor AutoML models with an overall accuracy improvement of 20% compared to that of the client's legacy system. We achieved overall accuracy rates of 80% and 70% with the top 500 materials at the most granular level possible.

Few Examples of High Volatile Products

