Improving Forecast Accuracy through Demand Sensing

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Summary: Our research assesses the feasibility and potential value of implementing Demand Sensing in the supply chain of a major consumer medical device company–Johnson & Johnson Vision Care. The motivation for this project was to find new sources of efficiency within a constrained production environment. Our approach was twofold: first, to statistically examine the accuracy of the current forecast system and second, to assess the pragmatism of Demand Sensing. The results of our statistical analysis suggest using alternative methods to forecast slow-moving SKUs. In addition, our research into advanced forecasting methods provides real world recommendations regarding the benefits and drawbacks of Demand Sensing approaches. We constructed three initiatives—one for each Demand Sensing approach—that can be used independently, or in any combination, to create a Demand Sensing forecasting system. We call these three initiatives Latency Reduction (LR), Downstream Data Integration (DDI), and Measuring the Impact of Demand Shaping Actions (DSA).

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KEY INSIGHTS

1. For product categories with lower sales volume, simpler forecasting techniques can be more accurate

2. Demand Sensing is made up of 3 distinct approaches, which can be combined for added improvement to forecasting strategy

3. The easiest way to implement Demand Sensing is to reduce the forecast cycle; e.g., from one month to a two-week model

Introduction

The competitive nature of today's commercial market forces companies to search for cost-savings in all areas. An ongoing subject for study and revision is a company's forecasting strategy. At Johnson & Johnson (J&J) Vision Care, the executive team is interested in improving the overarching statistical models that govern their forecasts. In addition to these high-level improvements, the team is also committing resources to finding novel ways of addressing the challenge of demand planning. One area of specific interest is "Demand Sensing," a newer concept that incorporates several approaches, such as including data from all levels of the supply chain network to adjust forecasts in real or near-real time.

The main goal of our research was to analyze the current J&J Vision Care forecasting process and propose suggestions for improvement while paying special attention to Demand Sensing approaches. In our final report, we created initiatives (one for each of the three distinct approaches to Demand Sensing) that summarize our findings. We call these initiatives Latency Reduction (**LR**), Downstream Data Integration (**DDI**), and Measuring the Impact of Demand Shaping Actions (**DSA**). Our intent is for these initiatives to assist J&J Vision Care with follow-on research or pilot programs incorporating our ideas and recommendations.

Forecast Accuracy

Our data analysis was driven by two data sets we were given at the outset of the project. The first was a set that included all shipment data within the United States (originating at the Jacksonville production facility/DC) from January, 2013 through June, 2016. The second set was a list of the forecasts J&J Vision Care used to predict future sales from January 2015 through August 2017.

From the shipment data, we characterized how demand changed over time, using several aggregation methods. We graphed the shipment data from the beginning and identified patterns, trends, seasonality, etc. for a few product families. We also processed the shipment data further by running a Pareto categorization on the SKUs we had data for. In total, we used the following segments: Brand (1DM vs. 1DM-A), Pareto (or A/B/C) category, pack size (90 vs 30), and SKU. We analyzed the demand data using a comparison across the segments of Mean, Standard Deviation, and Coefficient of Variation. We found that the categories that are responsible for smaller proportions of total demand carried the highest coefficient of variation (that is, the volatility of the demand). The results of our analysis are detailed in Figure 1 below.

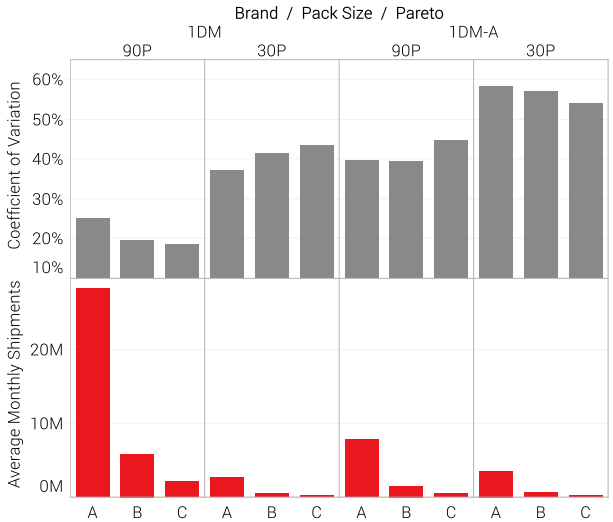

Figure 1: Average Monthly Shipments vs Coefficient of Variation

We created a list of other possible forecasting techniques (simple exponential smoothing, double exponential smoothing, naïve, 2-month average, 3-month average, etc.) and compared them against the J&J Vision Care inputs using MAPE, PVE, and RMSE. The results of our analysis suggest that J&J Vision Care could benefit from using simpler forecasting techniques for product categories with the smallest relative demand. This is due to the inherent demand variability that these products experience. A sample of our data is below, in Figure 2. The table shows how a naïve forecast can improve Absolute Percent Error (APE) for some product categories. Specifically, we found a significant statistical improvement in the 1 Day Moist 30-Pack product category.

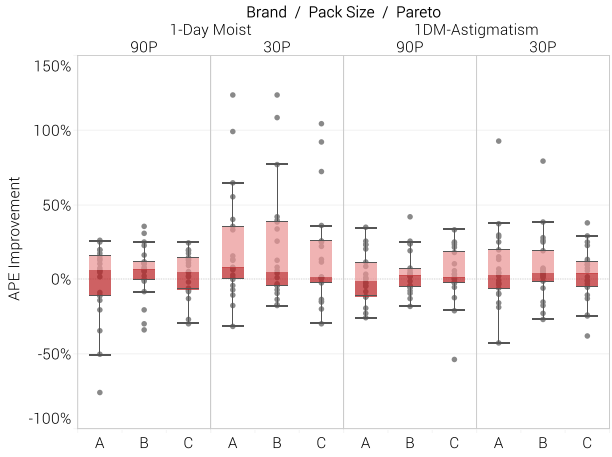

Figure 2: Naïve vs. Lag 01 forecast

Demand Sensing

As we investigated the forecasting system and S&OP process at J&J Vision Care, we considered the three approaches of Demand Sensing: LR, DDI, and DSA. Each of these ideas can be used independently, or in any combination, to achieve a Demand Sensing forecast model. The difficulty comes from establishing which pursuits are feasible and which are worth the upfront costs.

Once we were operating with a clear picture of what Demand Sensing entailed, we looked holistically at the work we had done so far, to determine where we could add value. The LR and DDI approaches applied well to this project. Even before we had a clear definition of Demand Sensing, our list of suggested improvements included things like shortening the S&OP cycle or incorporating POS data into the statistical forecast. We mapped out the S&OP process J&J Vision Care employs to help analyze the third approach—DSA—to establish whether we could make progress there as well. In order to incorporate the ideas from DSA we would need to have historical records of when managers at J&J Vision Care executed demand

shaping actions. These actions could be in the form of new product launches, price changes, promotions, and forward-buy arrangements. J&J Vision Care participates in all of these demand shaping actions, but does not currently keep a master record of when they occur, or to what magnitude. The records are mostly kept in the form of summaries from executive S&OP meetings. If we wanted to include this data, we would have to find a way to precisely quantify the records and roll them into the existing statistical forecast. We determined that the background work to make DSA manageable would take longer than a year, and thus was infeasible on our given timeline. We decided to analyze the situation qualitatively, and give suggestions for future work opportunities.

That left us with LR and DDI. As mentioned before, both initiatives fit well the current situation at J&J Vision. We concluded that these two ideas were worth detailing so that the executive team could make the final determination on whether to go forward with a pilot project. To make our suggestions easier to convey, we constructed a few diagrams that outline the S&OP process at J&J Vision Care. The first was the existing process, in the form of a flow chart. Next, we outlined the functional differences that arise from implementing demand sensing. Figure 3 shows how the forecasting and S&OP process would change if J&J Vision Care pursued the LR demand sensing initiative.

For the purposes of this summary, we chose to focus on the easiest Demand Sensing initiative, LR. For a thorough explanation of the other two, DDI and DSA, see our Capstone titled "Improving Forecast Accuracy through Demand Sensing" (MIT-CTL 2018).

Conclusion

Our statistical analysis of the current forecasting system at J&J Vision Care yielded interesting results. For smaller product categories, the forecast was not producing optimal results. We recommend J&J Vision Care consider the use of simpler forecasting techniques for the 30-Pack pack size category and, more specifically, for the 1-Day Moist 30-Pack product segment.

Demand Sensing is an advanced form of forecasting that draws upon three core ideas: Latency Reduction (LR), Downstream Data Integration (DDI), and Measuring the Impact of Demand Shaping Actions (DSA). In summary, we recommend that J&J Vision Care approach Demand Sensing by attempting all of the three approaches outlined in our research. Each approach has its own sets of challenges to overcome in order to obtain improvements over the current system. The LR method outlined in this summary will require a significant change in the way J&J Vision Care executes its S&OP process, potentially becoming more costly. Using the DDI and DSA initiatives will require extracting, processing, and consolidating data that is not yet readily available. They will also require the creation of a novel Demand Sensing model that is capable of delivering more accurate results. J&J Vision Care should collect the requisite data for DDI and DSA and conduct an analysis to see if our recommendations are cost-effective.

On a final note, it is important to point out that while it is possible to use all three techniques independently, combining them and using them simultaneously would potentially provide the best improvements overall.

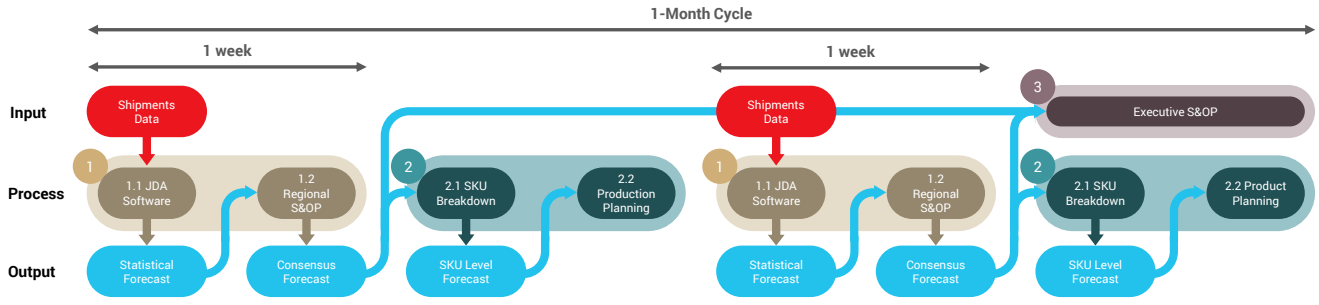

Figure 3: Latency Reduction – Demand Sensing Initiative