

Improving Service Level with Component Inventory Management

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Sponsor: Global Medical Devices Manufacturer

Topic Area: Inventory Management

Summary:

For medical device companies, product stockouts can have a devastating impact. Our task was to understand the drivers of our sponsoring company's service level and to define actions that can reduce the risk of stockout. We found areas of improvement in forecasting, frozen period planning, and supplier performance metrics that will reduce the risk of stockouts in future planning periods.



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KEY INSIGHTS

1. Is important that a supplier can trust a company's forecast to align efforts and expectations on medium-long term production.
2. Implementing short-term but realistic frozen periods based on direct supplier input can help suppliers better plan for times of high variability and increase a company's service level.
3. Alignment of a supplier's performance metrics according to a company's segmentation of suppliers based on critical components can help them set common goals and align their efforts.

Our research question was as follows: *What are the key drivers behind component inventory service levels and what actions can the sponsor company take to improve service level (reducing the risk of stockouts)?*

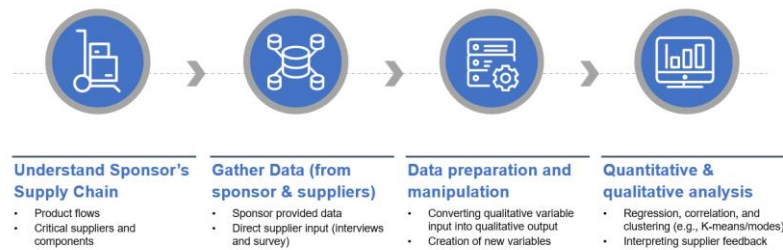
Beyond the typical safety stock formula that incorporates only consumption and lead times with a target service-level, we evaluated additional planning levers that impact supplier service level. We interviewed and surveyed suppliers regarding their forecasting, production planning, and internal inventory management practices, and incorporated both qualitative and quantitative elements into our analysis of the key focus areas for improving service level with our sponsoring company's component suppliers.

We discussed key actions related to the sponsor's supplier planning portal in the areas of forecasting, frozen period planning, and supplier performance metrics that would reduce the risk of stock out for future planning periods.

Introduction

In every company, determining an optimal inventory level balances the desired service level with the costs of holding too much inventory. For the medical device industry, the stakes are high as interruptions in the supply chain of devices used by hospitals and in operating rooms can have a devastating impact. In this capstone, we focused specifically on component inventory sourced from a variety of suppliers that is used for assembly and finished goods production.

Figure 1: Methodology Diagram

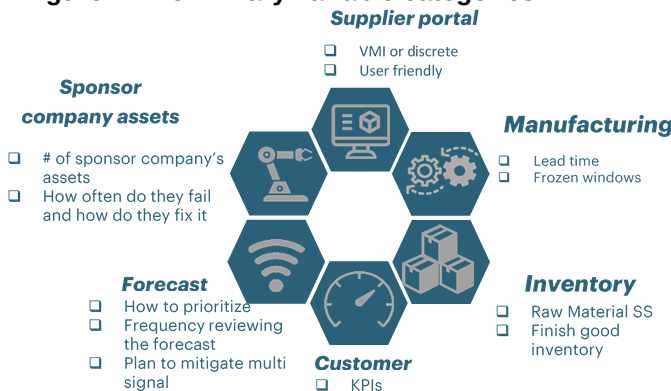


Data and Methodology

The high-level approach of our methodology is summarized in **Error! Reference source not found.1**. In the initial stages, we focused on understanding the complexity behind the sponsoring company's supply chain. We worked with them to narrow our scope to a group of "top" suppliers responsible for roughly 80 percent of finished goods revenue (following the Pareto principle).

Then we focused on gathering historical data on inventory levels, demand, and suppliers' shipments. After we collected this information from the sponsor company, we determined that direct supplier input would also be required to gain a holistic understanding of the variables that affect the service level since they were the primary source of information. We designed a series of interviews and supplier surveys to collect this information based on the Figure 2 categories.

Figure 2: Preliminary variable categories



After gathering the required data, we did data preparation and manipulation. First, we consolidated the survey with the sponsor company data above mention and formatted it. Since the supplier survey questions were a mix of categorical and numeric responses, we converted the qualitative responses to numeric values.

Then we focused on analyzing the data to answer our research question through a quantitative and qualitative analysis.

For the quantitative analysis, we tried various strategies to gain a better understanding of the relationship between the variables and segments of components and suppliers. We began with regression and correlation techniques to identify those connections, then performed segmentation techniques with K-modes to detect any service level patterns between various components or suppliers.

For the qualitative analysis, we took into consideration the 26 responses that we received from the supplier's survey (a 93% response rate). To better understand the patterns and the impact on service level, we began a deep dive into the supplier survey responses to detect similar behaviors that can help us define specific recommendations.

We discuss the results of the search for relationships among service level and the other variables, as well as our insights from the supplier survey data in the following section.

Result and Analysis

After concluding the supplier survey and importing the additional sponsoring company data, we analyzed the correlations between the behavior of the suppliers and their historical service levels (by using the mean of service level). In the correlation matrix we did not find a strong relationship between the service level and any of the other variables, meaning that we needed to look at the data more qualitatively and dig deeper into specific supplier survey insights.

In this qualitative analysis we scrutinized the survey's responses to see if there was any segmentation of suppliers that could be done that might explain the behaviors, preferences, and performance of the components or suppliers. We found three different areas of analysis: (1) Supplier Perception of Forecast Accuracy, (2) Realistic Frozen Windows, and (3) Supplier Service Level Performance Metrics.

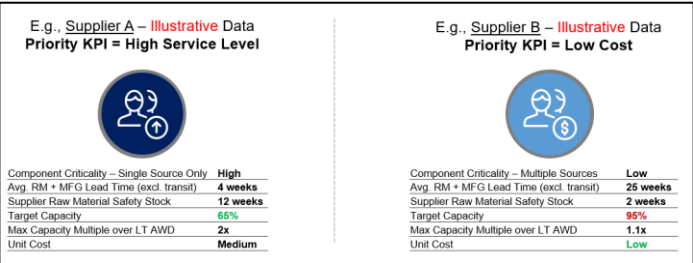
Supplier Perception of Forecast Accuracy: At the end of the supplier survey, an optional free text field question inquired what change the sponsoring company could implement that would help suppliers improve their service levels. Of the 23 responses to this question, 15 referred to increasing forecast accuracy or to increasing visibility into future demand. The recommendation is to ensure that the forecast is accurate, updated, and properly communicated to suppliers. To inspire confidence in the forecast, it is important to align the sponsoring

company's goal with the suppliers, so they work together to reduce their risks by not incurring high expenses when a high demand variability is presented.

Realistic Frozen Windows: In the supplier survey, responses to one of the survey questions indicated a significant increase from currently implemented to desired frozen planning windows. Unsurprisingly, the suppliers that stated the need for an increased window were mostly metal or electronics suppliers, which generally require longer lead times in sourcing raw material, as well as additional manufacturing complexity compared to packaging or plastics suppliers. By implementing true frozen windows and incorporating them into their planning system, the sponsoring company may need to raise safety stock in cases where there is a perception (driven by the new frozen period) of increased lead time. However, the risk of stock out will likely outweigh any increases in holding costs in these cases.

Supplier Service Level Performance Metrics: With limited long-term visibility due to forecast trust challenges, the suppliers we interviewed discussed making trade-offs between cash, cost, and service level. Segmenting suppliers (and components if necessary), then setting and communicating performance targets accordingly will help align service level goals and reduce costs across the supply chain. One example of this tradeoff can be seen in Figure 3.

Figure 3: Illustrative example of service level tradeoffs



In this example, “Supplier A” built in extra capacity and invested in raw material to be able to meet spikes in demand and maintain service through supply issues, whereas “Supplier B” may not have the ability to tie up cash in additional raw materials beyond a bare minimum and drives cost savings through a high-capacity utilization. This tradeoff of putting cost and cash above service may be acceptable for the sponsoring company if the components are dual sourced and not so critical for finished goods production. However, for critical components, the sponsoring company should establish service level and capacity targets that prioritize service level instead. After determining which KPIs are most important based on segment,

these transparent and supplier-specific goals can be measured on a regular basis (i.e., quarterly, or monthly where possible) to ensure incentives are aligned appropriately and service level trade-offs due to previously discussed challenges (i.e., forecast trust/accuracy, lack of frozen windows) do not need to be made.

Conclusion

At the beginning of this project, we sought to help the sponsoring company answer the research question regarding the key factors behind the service level and what actions can be addressed to improve it.

In our analysis we uncovered three different recommendations:

- Trust in the Forecast: Giving suppliers the ability to trust in and plan based on medium-long term forecasts
- Realistic Frozen Windows: Implementing realistic frozen periods based on direct supplier input
- Supplier Performance Metrics: Aligning transparent supplier performance metrics based on the sponsoring company's segmentation of suppliers based on component criticality

For future research opportunities, we recommend an additional research project focused on building a simulation model that helps predict the service level of suppliers based on the different types of supplier characteristics and variables discussed in this capstone. To complete this project, we recommend addressing the current limitations in our analysis, which include (1) maintaining more robust historical service level data and metrics that detail the different reasons why a supplier had a stock out or near-stockout in the past and (2) expanding the supplier survey to a larger group of suppliers to get an increased statistical sample for a model to be trained appropriately.

For the sponsoring company, we are confident that further action in the areas discussed above, as well as the further research opportunities, will allow them to make significant service level improvements in their component inventory supply chain for their complex, global portfolio of life-saving devices.