Improving Inventory Strategies for Consumable Materials

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Topic Areas: Inventory, Strategy, Manufacturing

Summary: A pilot program was created and implemented that successfully integrated a new inventory approach affecting ten strategically important part numbers for a defense contractor. Pilot program materials were pushed out to the production floor via a Kanban inventory management system for storage until time of use. Benefits realized include scrap frequency reductions and a significant positive impact on labor cost avoidance through improved process flows.

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KEY INSIGHTS

1. Moving inventory storage to the production floor at point of use will allow for improved process flows and visibility of traditionally difficult to manage materials.
2. Significant cost savings can be realized by more closely integrating stock keeping strategies with operations in the form of both labor avoidance and reduced scrap occurrences.
3. In the absence of reliable data, one must not be afraid to create new metrics in order to drive meaningful change.

Introduction & Motivation

A critical element of successful manufacturing is the effective management of consumable material. Management of these materials is much more complicated compared to traditional piece parts with known quantities. The difficulty of managing these materials increases as the complexity of the finished product increases. Therefore, highly specialized industries such as aerospace and defense manufacturing often struggle to manage these types of inventories efficiently. A project was created to explore the methods by which an aerospace industry company can improve upon their current inventory management such consumable material.

Despite being incredibly successful in the management of piece parts, WOB Corporation (company name altered for privacy) is challenged in the management of consumable material. Consumables can be broken down into two main categories: As Required and Shelf Life Limited material. Unlike piece parts, which have a known and defined required quantity, As Required and Shelf Life Limited material requirements may vary from one build to the next, even on different builds of the same parent assembly or part number. This variation from one product to the next adds a significant degree of uncertainty to inventory planning strategies. Furthermore, several items that fall under the Shelf Life Limited classification have stringent quality requirements with regard to the expiration date. This combination of variation, storage constraints, industry specific traits, and uncertainty renders traditional inventory approaches ineffective.

In reviewing the previous inefficiencies in the management of Shelf Life Limited material for WOB Corporation, the it was found that nearly $100,000 in material has been scrapped per year since 2010 due to shelf life expiration in the given business unit at one single manufacturing location alone. Moreover, there was a troubling increasing trend in scrap amounts over the previous eight years (see Figure 1). A main contributor to this waste is the company's extreme commitment to risk avoidance. Like other aerospace industry companies, WOB is concerned that material availability issues may impact delivery promises to the customer. An unfortunate side effect of such severe aversion to jeopardizing the customer delivery schedule is that traditional inventory management strategies are either ignored or simply not adopted. The looming threat of stopping the production line prevents resources from being allocated efficiently to solve this inventory problem.

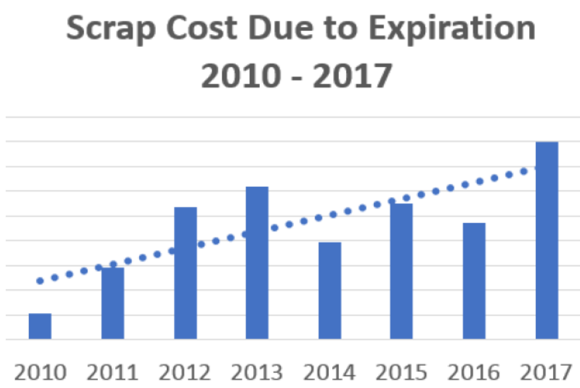

Figure 1: Scrap Cost due to Expiration, 2010-2017

Current Practice
The first initiative was to observe the current practice. This is a crucial step to understand how the legacy process functions. Only once the legacy process is understood can meaningful suggestions for improvement take place. The process was broken down into two distinct parts: the front-end (shop floor worker) and back-end (stockroom technician) process.

On the production floor, it was observed that operators are routinely in need of expendable and consumable material. However, all this material was stored in the stockroom, not near to the production floor. Therefore, at the time of need, the shop floor technicians would need to leave their workspace, exit the area, and proceed to the stockroom several hundred feet away. Once there, they would need to wait in queue if the stockroom was busy. After getting the required material, they would then return to their work station. On average, this process was observed to take 26 minutes of non-value-added time per each occurrence.

The back-end part of the process also created non-value-add activity. Upon issuance of any consumable material to the shop floor worker, the stock room technician would then transact said material into the MRP system. However, given the nature of many consumable items, the transaction quantity would often be inaccurate. The customary practice for any material that was not in a discrete quantity would be to record an infinitesimally small quantity not reflective of the actual quantity issued. Locally, this would be called a “placeholder value.” This was done to capture the fact that material was indeed issued, but both the stock room technician and shop floor worker were uncertain of the actual quantity provided. The small transaction quantity had greater downstream effects, however. First, the small transaction quantity would eventually result in all the material being consumed, yet the system would still show high inventory levels. To remedy this problem, a scrap transaction would be done to remove the leftover quantity from the system. The scrap transaction was problematic as it sent a signal to management that the operation was inefficient in the use of materials. Furthermore, it would leave the supply chain function blind to the actual stock levels, sometimes even leading to costly stock out events.

Data Collection
A database query was created that pulled the transaction history over a multi-year period. This query collected all instances of when consumable material was either received from a vendor or was issued to a work order for future consumption in the manufacturing process. The inbound transactions (called “Stock Receipts”) were verified to be accurate and reliable with respect to the quantity recorded by the MRP system. However, the “placeholder values” previously discussed caused the quantity data for outbound transactions (called “Production Issues”) to be inaccurate. What was accurate however was the number of times a Production Issue occurred. Therefore, the quantity of Stock Receipts for a given part number could be divided through by the number of instances in which a Production Issue occurred for the same part number to generate a new metric. This new value was called “average issuance quantity.” Using this new metric, the team was able to begin recording the calculated value in the system when transacting a Production Issue. This aligned the system closer to reality and helped material planners within the organization begin to trust their own system displayed values for the first time in years.

Using a two-year span of data generated by the created query, it quickly became evident that out of a universe of approximately eighty part numbers, roughly fifteen part numbers accounted for just over 80% of both the number of issuances and cumulative sum of quantity received over the designated period. From here, ten part numbers were selected for further evaluation. When selecting the ten part numbers for additional evaluation, an effort was made to find diversity in the materials selected. This list of ten part numbers included: two different types of wire, two different types of solder, two different types of adhesive, two different types of sleeving, solder paste, and one chemical cleaning element. This forced diversity was a key factor because it would enable scalability in the future with any related materials. The list of ten items chosen, along with the resulting query data of associated Production Issue (seen as “PI”) transactions and Stock Receipt (seen as “SR”) transactions can be seen in Figure 2.

ITEM NUMBER	Description	Transaction Type	Count of Transaction Quantity	Sum of Transaction Quantity
⊟1	⊟ADHESIVE	PI	1777	[redacted]
		SR	[redacted]	2139
⊟2	⊟SOLDER PASTE	PI	236	[redacted]
		SR	[redacted]	85520
⊟3	⊟CONATHANE	PI	339	[redacted]
		SR	[redacted]	11
⊟4	⊟ADHESIVE 2	PI	177	[redacted]
		SR	[redacted]	293
⊟5	⊟SLEEVING	PI	205	[redacted]
		SR	[redacted]	400
⊟6	⊟SLEEVING 2	PI	68	[redacted]
		SR	[redacted]	100
⊟7	⊟WIRE	PI	131	[redacted]
⊟8	⊟WIRE 2	PI	121	[redacted]
		SR	[redacted]	500
⊟9	⊟SOLDER	PI	594	[redacted]
		SR	[redacted]	75
⊟10	⊟SOLDER 2	PI	189	[redacted]
		SR	[redacted]	75

Figure 2: Data for Selected 10 Part Numbers

Kanban Implementation
With the “back-end” of the house in order, the next step was physical implementation of a Kanban system on the production floor. In order to calculate the appropriate Kanban bin size, the average demand needed to be known. However, this element would prove to be problematic to obtain, given the variable nature of consumable items. To remedy this challenge, the average demand data was adapted from the newly created average issuance quantity metric. Using the new metric in the bin size calculation enabled the company to move forwards with the Kanban application.

However, implementation was easier said than done, as physical space came at a premium out on the production floor. What first may have appeared to be a trivial task, getting commitment on the floor from the Production Manager turned into a lengthy endeavor. The idea of moving stocked material from the stock room to the floor for holding until the time of use made the production team uneasy. However, by rolling out one item at a time to the shop floor, a phased approach put the anxiety of the production team to rest.

Results
As materials moved from the stock room to the floor, the first benefit to become apparent was the improved process flow. With the legacy process, the time required for an operator to retrieve material was observed to take an average of 26 minutes. Under the new process with Kanban locations on the shop floor, this process was cut down to 10 minutes. To quantify the effect this had on WOB Corporation, one can look to the significant impact this time improvement had on labor efficiency increases for the first item implemented through the pilot program. This material was an adhesive that was identified as item number ‘1’ in Figure 2. The projected number of issuances (uses) per delivery is shown in Figure 3. Each delivery comprises a full set of one dozen different top-level assemblies. It also shows the expected savings contribution this one material will bring to the company over the course of each delivery using a pre-defined internal labor rate. By implementing this one item on a Kanban system, WOB Corporation is expected to realize a labor improvement equivalent to $12,000 per delivery. The other nine pilot program items are estimated to generate another $10,000 in savings per delivery.

Savings Per Shipset for First Pilot Item (Item No. 1)

	Product 1 Operations Affected	Product 2 Operations Affected	Product 3 Operations Affected
Number of Uses	124	261	50
Time Saved Per Operation (minutes)	16	16	16
Time Per Ship Set Delivery (minutes)	1984	4176	800
Time Per Ship Set Delivery (Hours)	33.07	69.6	13.33
Savings per Delivery	**$3,472**	**$7,308**	**$1,400**

Figure 3: Labor Savings per Delivery for Item No. 1

Scrap occurrence rates have significantly improved as a direct result of the implementation of the new inventory management system. Over the first three months of the program, there have been only 18 instances of a scrap transactions recorded across all ten pilot program part numbers. Compared to a total average of 36 instances of scrap transactions for the same grouping of part numbers over the time period in the previous two years, there is a clear 50% improvement in overall scrap occurrence rate. However, it is difficult to quantify the true monetary and volume impact of this improvement in scrap rate due to the unreliability of the historical transaction data. Anecdotally, both the production team and stock room manager have stated that the actual quantity of scrap has been noticeably lower, despite the lack of empirical data to prove this point.

Conclusion

Through careful consideration of the impacts and challenges that consumable material has on inventory strategy, WOB Corporation has mitigated inventory variation through the implementation of a Kanban system. This capstone project explored how traditional inventory management strategies that are commonplace in other industries can be adopted, modified, and customized in an aerospace and defense manufacturing setting. Traditional inventory management models examined mostly assumed demand and lead time patterns of defined variability. However, a consistent demand pattern rarely occurs in a manufacturing environment of this nature, and therefore leads to the pre-existing inventory models falling short. In response, this capstone project presented and acted upon opportunities to use such pre-existing inventory strategies as a foundation to build upon, creating a robust inventory management program. The resulting effects of this program increased manufacturing efficiencies, improved upon legacy supply chain processes, enhanced material flow in the work space, and yielded a positive financial impact for WOB Corporation.