"Intro to Replenishment Pull" - Webcast Addendum

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Q: Have you ever had to take into account variation in lead time?

A: Yes! The basic safety stock formula is actually fairly conservative (it tends to create excess safety stock), so the formula ends up compensating for more than just the variation in demand. In addition to the assumption that demand is normally distributed, the basic formula also assumes that *every demand event is an independent event*. This means that high demand today could be just as easily followed by high demand tomorrow.

In reality, demand tends to be somewhat autoregressive in its behavior. As a result, while we may have a short period of high demand, eventually the demand will revert to its long-term mean value. This assumption of independence is what gives us the square root of lead time term in the equation. Because the assumptions of normality and independence are almost always violated, the equation tends to give us more safety stock than just the variation in demand would require. As a result, we have a little "extra" safety stock to buffer against other sources of variation, including lead time variation, scrap, and shrinkage.

There are some formulas that explicitly account for lead time variation in the formula. They can be found online. The most common approach is to transform the simple standard deviation of demand term into the following term:

$$Average\ Demand\ \times \sqrt{\left\{\frac{(C_S^2 + C_D^2)}{2}\right\}}$$

In this equation, the Average Demand rate is multiplied by the square root of the sum of the coefficient of service time squared and the sum of the coefficient of demand squared, divided by two. This formula combines variation components from both demand and service time into a single, blended variation component for use in the original safety stock formula.

Q: How would you use your model to demonstrate the impact of having a fixed delivery time (once/week)? This says that the lead time is variable and the delivery cycle is fixed.

A: This question brings up a very common situation with Replenishment Pull systems. Many replenishment processes operate on a fixed cycle. This could be the weekly delivery run of a truck, or a fixed "window" for production in a manufacturing process. In this case, the lead time of the replenishment should be very stable (perhaps one week if that is the frequency for the delivery truck making its rounds). The Cycle Time of the pull system is also defined by this externally mandated schedule.

In a perfect (no variation) world, the pull system would operate perfectly with the Cycle Time and Lead Time set to match the external schedule. However, with variation present, the pull system may not trigger in time to catch the fixed (weekly) replenishment schedule. If the pull system fails to trigger on time (due to demand being even just one piece lower), then the pull system would have missed its chance for replenishment, leading to two cycles of demand for just one cycle of replenishment. This will almost certainly result in a stock out.

In this case, the trigger rule for the pull system must be modified. The simple rule of "trigger when the on hand + on order inventory falls below the trigger point" must be modified. The new rule is "trigger when your scheduled time window comes due". If demand has been light, then the pull system will trigger earlier that it would have without the modified rule, and the order will be smaller than usual. If demand has been heavy, then the pull system will trigger later than normal and the order will be larger than usual. You will need to keep a close watch on your safety stock levels and consumption during the start-up and stabilize of a Replenishment Pull system in this environment.

Q: Is replenishment pull the best system to use in a high-mix/low volume contract manufacturing environment where we know demand in advance, but our processes have high variability?

A: Probably not as the exclusive system for managing parts, but it certainly can be part of the solution. Replenishment Pull systems are best suited to parts that have repetitive demand. I have been working with a machine shop where the batches are small, and demand is highly variable. However, about 50% of the parts made are repetitive and on long-term contract. In this case, it makes sense (and simplifies the planning and scheduling process) to move these parts to a Replenishment Pull system. The Working Stock is sized to meet the typical order size of the customer, with a little safety stock thrown in for good measure.

For the parts that are not repetitive with any reasonable frequency, the MRP system is used to perform the traditional master scheduling, BOM explosion, and work order issuing process. The benefit of putting the repetitive parts on pull is that they then, for the most part, manage themselves. That leaves more time for the master planner and schedulers to deal with the non-repetitive and new parts.

Q: Comment: Sometimes services require "research" or fact-finding activities, which can't necessarily be determined well in advance, but often times customers want answers "yesterday". It seems like "replenishment pull" could be implemented to improve services in that case... I think it also applies there as well.

A: Perhaps, but as you say, it is often difficult to know what the customer will need in advance of their arrival. One interesting use of Replenishment Pull I have seen was in a hiring process. Prescreened resumes were inventoried based on a Replenishment Pull system. This kept the proper number of prescreened resumes "in stock" without wasting resources screening too many resumes, or finding you don't have enough to choose from when a position does come available.

When examining service processes, look for any portion of the service that is commonly repeated. This is actually very similar to the high-mix/low-volume job shop example above. If you can find repetitive work/parts, you may have something you can use Replenishment Pull to manage.