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Lean Thoughts

BULL WIP

the effect in your supply chain

It has always been advocated that in order to smooth your production planning you need to get as close to your customer demand as you can. In the past we have incorporated VMI techniques which included the use of customer Kanbans, Web-Cambans with various degrees of success. The following edited excerpts from a paper published by Dr. Stephen Disney continues the discussion on the Bullwhip effect in supply chains. If you want to read the full paper including all of his formulas visit; bullwhip effect in supply chains

The bullwhip effect is a dynamical phenomenon in supply chains. It refers to the tendency of the variability of orders rates to increase as they pass through the echelons of a supply chain towards producers and raw material suppliers. A classic example of the effect is baby nappies or diapers. Babies are fairly regular in their use of nappies - they have a new nappy (almost) every time they feed. Sure, there is seasonal variation in the birth rates as more babies are conceived in spring Neither-the-less, this seasonal variation is small compared to the widely fluctuating and erratic production rates experienced by the diaper manufacturer after the orders have passed through the supermarkets and distribution centres.

Bullwhip creates unstable production schedules. These unstable production schedules are the cause of a range of unnecessary costs in supply chains. Companies have to invest in extra capacity to meet the high variable demand. This capacity is then under-utilised when demand drops. Unit labour costs rise in periods of low demand, over-time, agency and sub-contract costs rise in periods of high demand. The highly variable demand increases the requirements for safety stock in the supply chain. Additionally, companies may decide to produce to stock in periods of low demand to increase productivity. If this is not managed properly this will lead to excessive obsolescence. Highly variable demand also increases lead-times. These inflated lead-times lead to increased stocks and bullwhip effects. Thus the bullwhip effect can be quite exasperating for companies; they invest in extra capacity, extra inventory, work over-time one week and stand idle the next, whilst at the retail store the shelves of popular products are empty, and the shelves with products that aren't selling are full.

There are various causes to the bullwhip effect. Lee, Padmanabhan and Whang (1997) [3] made ground-breaking contributions and re-ignited interest in the subject [4]. Their main contribution was to analyse four different causes of the bullwhip effect; batching, shortage gaming, lead-times and demand signal processing. However, there are other sources of the bullwhip effect [5]. Together demand signal processing (the way that replenishment decisions are made) and the impact of lead-times have previously been called the Forrester Effect [6].

Methodological approaches to solving the bullwhip problem

The biggest decision to make is whether to study the bullwhip problem in discrete or continuous time. In discrete time, system states (demand rates, inventory and WIP levels) and replenishment orders are made at the equally spaced moments of time. In between these moments of time, nothing is known about the system. In continuous time the systems states are monitored at all moments of time and the order rate is continuously adjusted.

Neither representation of time is incorrect; it is just that one representation of time may be more suitable for a given situation than the other. For example, in a grocery supply chain, supermarkets total up demand that has occurred during the day, a replenishment order is generated and a delivery is despatched from the distribution centre overnight

Where Lean Thoughts can become Reality

"Unless you try to do something beyond what you have already mastered, you will never grow."

Ronald. E. Osborn

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Lean Thoughts

Bull WIP, cadence and compression …

This scenario is very suitable for a discrete time analysis. A petrochemical plant, on the other hand, may be able to continuously adjust its production of different grades of product to reflect the current demand rates for each grade. This type of scenario is more amenable to a continuous analysis.

Traditional supply chains
In a traditional supply chain each echelon makes its own replenishment decision, based on its own local information. This local information often includes sales inventory and orders placed, but not yet received or WIP. Most supply chains operate in this mode. The problem is bullwhip increases geometrically in traditional supply chains. Every time the order passes through an echelon of the supply chain, the variance of the order rates "multiples up", and this causes inefficiencies.

Information sharing
Some supply chains have the ability to share point of sale data to the end consumer with other members of the supply chain. Consider, for example, the supermarket supply chains in the UK. As the barcodes are scanned at checkouts an electronic file is populated from which sales patterns for particular products can be determined. These sales patterns are then transferred (sold even) to suppliers. Often suppliers use this in capacity planning activities, but the real benefit comes from using it in their replenishment / ordering decisions (see Figure 2). Using the POS data solely in the capacity decisions has no effect on the dynamics of the supply chain; the bullwhip effect still exists, and it still increases geometrically. Thus suppliers are left dismayed, wondering why the retailer's orders fluctuate widely despite fairly steady sales.

However, if suppliers are sophisticated enough to incorporate this information into the forecasts that they use inside their replenishment decisions, then the bullwhip effect can be greatly reduced. This is especially true for echelons further away from the end consumer as now the bullwhip effect will only increase linearly as it proceeds up the supply chain.

VMI- type supply arrangements
The gold standard in supply chains structures however comes from completely eliminating replenishment decisions. This can be done via Vendor Managed Inventory (VMI) arrangements. In VMI supply chains suppliers have complete visibility of the downstream supply chain; they can see end consumer demand, their customer's inventory levels and the contents of the pipeline (WIP). They can then base their replenishment rules on the state of the complete downstream supply chain. It is then possible to get a multi-echelon supply chain to act dynamically as a single echelon. This effectively removes the bullwhip problem from the supply chain.

Schematic of a VMI supply chain
It is often assumed that the supplier is managing the retailer's inventory. This is simply unacceptable for many retailers, as they consider their inventory management skill to be a core competency of their business. However, the supplier does not need to be in direct control of the retailer's inventory. . It does not matter who's "hand" is controlling the "cup" (the cup is an analogy for a truckload of product) to move the inventory from one company to the other. It could be either the retailer or the supplier. What is important is not who owns inventory or who makes the decisions. What is important is how decisions are formed and what information is used within them.

Cadence
We are finding that by identifying the cadence of activities within the administrative processing and making the necessary adjustments the refresh rate of discrete actions can become closer to continuous reviews, hence reducing inventory and production fluctuations. In the end it is all about lead-time reduction to increase agility to react to demand. (richard)

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