

SUPPLY CHAIN COMPLEXITY, VARIABILITY & METRICS

This paper describes how poorly designed supply chain metrics interact with variability (that well known destroyer of supply chain performance) to create forms of (damaging) behaviour common to Complex Adaptive Systems. It goes on to recommend how variability and destructive CAS behavior can be minimized and supply chain performance greatly improved.

Variability

Most ex-stock supply chains are driven by item level time-phased forecasts through an MPS / MRP engine. Such forecasts, of course, are always wrong, and MRP therefore propagates the forecast error up the supply chain resulting in too little or too much being supplied and unbalanced inventories. The consequent generation of MRP exception messages, whenever safety stock consumption is predicted, inevitably results in schedules being changed to avoid perceived service threats and these cause the variability that creates cost generating supplemental inventory – extended lead-times, use of unplanned capacity and unbalanced inventory growth. And if long time fences are used to try to prevent such schedule amendments then we have responsiveness degrading and inventory rich high work in process instead. The variability is pushed upstream to behind the time fence - and still significant service issues occur!

To make matters much worse, MRP's use of fixed lead-times and dependent demand calculation propagates and amplifies any source of variability (be it demand or supply side) up and down the supply chain through the impact of batching and latency.

Complexity and Metrics

The propensity of supply chains to generate unplanned inventory positions in response to flow variability and the poor design of company performance metrics is because supply chains are Complex Adaptive Systems (CAS) rather than a linear chain.

Complex Adaptive Systems are those that manifest chaotic or non-linear behaviour that, like the weather, makes them very difficult to predict as outcomes are subject to significant latency, often involve circular/amplifying feedback loops and are heavily dependent upon the minutiae of original conditions. Unlike pure 'chaos' however, a CAS also involves the concept of 'agency' that really just translates into the fact that they are composed of many players, or groups of players, with inter-dependent objectives and who have the ability to internalize information, to learn, and to modify their behaviour as they adapt to changes in their environments. The upshot is that a CAS demonstrates an 'emergent' type of system behaviour that, while it can be described in general terms, cannot be accurately predicted, extrapolated from the behaviour of its component parts or, in any way, optimized because any apparent linear relationships are constantly in flux. Examples of CAS can be recognised in the

behaviour of an economy, an ant colony, a social club, the brain/consciousness and genes/evolution.

This phenomenon can be observed in many supply chains as the contrast between the commonly articulated desire of supply chain participants to 'optimise' performance opposed to the reality of the common emergent behaviour of a continuous oscillation between focus upon 'conflicting' objectives such as service and inventory reduction. Another is the continuous tension between the Supply Chain's desire for responsiveness and low inventories and the need for Operations to achieve GAAP driven overhead / labour recoveries. This often leads to excessively large batching and supply becoming de-coupled from service requirements simply to achieve a recoveries number that is in danger of being missed because of past production hold ups or because demand is lower than expected. In both cases some form of inventory re-balancing action is inevitable at a later date as the system oscillates back to the customer service focus.

A common trait inherent with these examples, and many similar, is not that the objectives are necessarily misguided in themselves (eg. high service, low inventory, low costs). But they tend to be distributed across the company with poorly designed KPIs that lead the various functions to undertake activities to achieve them that actually conflict with each other and any over-arching performance objective (eg. such as high ROI), and thereby lead to overall continuous poor performance that oscillates between alternating forms of inadequacy.

The Way Forward

The way forward for companies that recognise they are suffering from excessive supply chain variability and these destructive aspects of mismanaging CAS behaviour is threefold:

1. Ensure all supply chain leaders and employees have an understanding of how supply chain variability impacts performance, how 'forecast push MPS / MRP' generates destructive variability and how the Demand Driven Adaptive Enterprise approach minimises its impact.
2. Minimise supply chain variability and generate Flow by becoming Demand Driven
3. Implement Flow based Metrics that support and encourage a Flow orientated supply chain which, by its very nature, delivers high service levels with right sized inventories and high/level loaded capacity utilization without compromise.

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