The specific supply chain issues in the Life Sciences industry

Companies in the Life Sciences industry face considerable challenges with commercial, operational and strict regulatory factors contributing to create a unique production environment. The manufacturing and quality process is typically between 8-10 months long and can span more than 100 countries. Add to this the fact that companies need to comply with regulations which vary greatly between countries or states, and we begin to understand how complex and convoluted the supply chain in this industry is.

When confronting these challenges, the Life Sciences industry needs to weigh up a range of often conflicting considerations; pressure to reduce the cash involved and maintain low stock levels while still minimizing the risk of not being able to meet customer deliveries. The ability of companies to understand and manage inventory is therefore crucial to delivery reliability and cost control.

Traditionally, this sector has a vertical structure. All the way from API, through primary and secondary manufacturing to sales and distribution, stock is owned by the company itself and therefore a tremendous amount of cash is tied up in a Life Sciences supply chain. As a result, conventional inventory management or advanced planning systems are not appropriate as they aim to optimize inventory locally, typically in a single node such as a distribution center or processing plant. This can create situations in which individual sites are very efficient, but the supply chain is still not performing optimally in terms of product availability and inventory costs. Risks factors are duplicated at each node and issues are multiplied through the entire supply chain. The consequence is that, although inventory along the whole supply chain is much higher than it needs to be, considering the parameters present (variability of demand, reliability, risk etc), demand is still not being met. Reducing inventory to its optimum level not only releases cash and improves responsiveness, it can also encourage a focus on supply-chain reliability, manufacturing accuracy and precise forecasting.

This article explains the supply chain and inventory management issues facing the Life Sciences industry and introduces Tefen’s global and holistic approach to optimizing inventories across a multi-echelon environment, thereby reducing process variability, optimizing push-pull and stock strategies across the supply chain and taking a statistical approach to analyzing safety stock and reorder levels.
The Life Sciences manufacturing processes and supply chains are typically V-plant structures (see figure 1) which suffer from several issues. Upstream processes are required to maintain high OEE and continuous processing. This means demand forecasts must be accurate as these processes are not flexible. Downstream processes then have to deal with a large numbers of distinct product types, languages and variations. Manufacturing processes therefore suffer high setup and lead time variability. Due to this complexity, inventory decisions made at one node along the chain (manufacturing centre, affiliate, warehouse or distribution centre) impact heavily on the required inventory levels at all other stages – particularly downstream.

A minimum stock policy in a warehouse supplying the end customer also has a knock-on effect upstream, at the amount of stock required in the node supplying this warehouse. Although it may sound ideal to maintain safety stock levels at a single location, these knock-on effects may not have been considered and the result is that excess stock is kept throughout the supply chain.

The causes of instability and high inventory in this situation can be summarized into 5 main root causes:

1. **Customer complexity:** Due to the global nature of many Life Sciences companies, customers are found throughout the world and the distribution network is dispersed and multi-layered, with each layer having safety stock and reorder levels. This complexity means that the system becomes unmanageable for many supply chain managers and inventory is kept high to cater for their risk aversion.

2. **Product variability:** Figure 1 shows a typical product ‘tree’ for a pharmaceutical product, with huge variability stemming from one source product. This means stock levels are maintained for a large number of products and inventory is kept within the supply chain for each – much unnecessary stock is held overall.

3. **Process instability:** Variability in demand, production and supply are all key factors in the inventory requirements within a Life Sciences supply chain – as in any other industry. The key statistical parameters include the standard deviation of lead time and daily demand \((x_{LT}, x_{DD})\) as these have a direct effect on the stock needed at each node, to maintain a desired service level under normal circumstances. Monitoring these factors is a key first stage in developing an optimized inventory model. Figure 2 shows the principle of statistical analysis or variability and the service level concept.

4. **Bottlenecks:** Throughout the supply chain, bottlenecks act as constraints to the overall system and cause queuing and stock build-up. Understanding and improving bottleneck performance is an important factor in reducing the stock required.

5. **Process constraints:** Other constraints in the process are those factors which are time-consuming, require minimum order quantities or have early differentiation. These additional constraints should be considered during the design and rollout of an optimized inventory strategy.

By understanding these factors and, above all, the variability of lead time and demand throughout the supply chain, an optimal inventory level and strategy can be developed to balance the service provided, ensuring costs are minimized, service levels are maintained and the company remains competitive.
Complexity can be overcome by targeting variability & synchronizing order strategies

As we have seen above, the inherent variability and complexity of supply chains in the Life Sciences sector form a considerable barrier to inventory reduction and the necessary cost savings required in today’s market place.

The right approach to inventory optimization is to target the described constraints to efficient performance and synchronize the inventory strategies across the supply chain, with the aim of yielding a holistic scheme that minimizes overall levels of stock without endangering delivery performance and responsiveness. To ensure a holistic and global strategy is implemented, the following considerations must be taken into account:

- Avoid multiple independent forecast updates in each echelon. You then become less reliant on demand data from the immediate downstream customers. This reduces the optimization of single nodes and prioritizes the overall optimization of the supply chain.
- Lead times and variations for all upstream suppliers must be accounted for in replenishment decisions. This will reduce the need for additional risk aversion as all variability is built into the inventory strategy.
- Visibility of demand, stock on hand, on order, committed and late must be maximized to reduce the complexity of the system and make the strategy easier to manage.
- Order strategies must be synchronized within and between echelons to reduce lead-times and attenuate stock levels where raw materials are shared.
- Services levels through the chain should be differentiated, based on customer needs and cost of capital.
- The interactive effects of replenishment strategies between echelons must be correctly modeled e.g. where capacity is constrained or raw materials are limited.

Building continuous improvement into an optimized strategy ensures future stability

Due to the complexity of the typical Life Sciences supply chain and the difficulty faced by managers in overseeing and monitoring the system, it is vital to establish a close working environment during the design phase of an optimized strategy. The design and pilot rollout should be structured into 4 distinct phases. Figure 3 shows a visualization of the correct approach.

In the initial stages of design, it is vital to fully map all of the supply chain, the various interdependencies and the current systems and processes used to manage local inventory and stock levels. In many cases, the strategies and systems used to manage stock levels, reorder quantities and safety stock limits may be different and in conflict to the overall optimization efforts. In this planning and testing stage it is important to increase the visibility of the current supply chain processes to all stakeholders and highlight the strategic goals of the structure to be designed and then align management to this.

Once management has been aligned to the aims and objectives of the optimization strategy and the system to be designed in later phases, the first stage of the design phase can begin. The aim of phase 1 in figure 3 is to ensure full management buy in and to put the required structure into place, to achieve not just an initial improvement but continuous and self perpetuating improvements over time. This is especially important to supply chain improvements as changes will be required to many different processes, involving numerous middle managers and staff across the world with differing cultures and approaches. A sustainable communication plan at the outset can help smooth over what could potentially be difficult changes for many intermediate supply chain managers.

In phase 2, there are two key work streams to be completed:

A. Data collection, normalization and prioritization:
When collecting the required data from across the entire supply chain it is important to factor in the wide range of variables at play while managing the strategic future business needs, internal and external stakeholder needs, demand plans, inventory policies and other system parameters. At this stage, any gaps in the data collected between sites should be identified and normalized before moving into the model design stage. Finally, the pilot site(s) should be identified at this stage to ensure communication is in place and that the finalized model can be used in a timely fashion.

B. Continuous improvement process implementation.
Parallel to collecting the required data, the structure to ensure continuous improvement must be set up. This may well have to be designed from the ground up, considering the following topics:
1. Organization: those responsible for on-going improvement must be identified, their roles and responsibilities defined and any training required put in place.
2. Change management requirements: personal development plans must be defined to support the change process and any knowledge management structures required should be put in place.

3. Continuous improvement roadmap: the change to internal improvements must be supported by adequate planning and communication. Additional improvement projects to assist in inventory optimization should at this stage be planned throughout the business; not just along the supply chain, but also in manufacturing, quality or forecasting etc.

It is only once these steps have been put into place that the design of the system can be started. Data on the various factors affecting stock levels, reorder levels and safety stock has been collected from throughout the supply chain and the various lead times and variations are known. There is now visibility of demand and of the differing local optimization efforts through each echelon and node. Normalization efforts should now be in place to lay a solid foundation for global optimization programs.

In stage 3, the statistical calculation of safety stock and reorder levels appropriate for each node and echelon within the supply chain is conducted. It is important to fully understand the various interdependencies between nodes and echelons as they affect the overall lead times and variations required to calculate the appropriate inventory levels. These levels should ensure that all nodes have the required stock to meet demand at the respective service level. During the pilot phase, results must be monitored and additional decisions made. The software platform to be used must be agreed and budgeted for, as overall implementation throughout a broad and geographically diverse supply chain can be costly and time consuming. Any further improvements to the agreed model can be introduced at this stage and retested if necessary.

**Implementation of optimized inventory management can yield significant cash flow benefits**

As in any industry, Life Sciences companies face considerable challenges in reducing working capital and stock levels whilst maintaining consistent performance. Tefen has worked with many leading Life Sciences companies across the globe and has seen firsthand the benefits of optimized inventory management practices. Reductions in held finished and semi finished goods by 109M were achieved in a major multinational pharmaceutical corporation and working capital reduced by 25% in another.

By implementing a global multi-echelon inventory management strategy, companies in this industry can achieve considerable benefits, thereby increasing visibility and transparency to what are typically incredibly complex and diverse supply chains. Managers can be freed from daily management of the system and overseeing tradeoffs between individual nodes. Instead of attempting to optimize their local situation, they can shift their focus to improving the overall supply chain and achieving the working capital reductions required in a challenging commercial environment.

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**Figure 3: Phases of a typical process**

- **PHASE 0:** Initial test
  - 3 Modelled data & parameters
  - 3 Agreed entitled inventory levels
  - 3 Delivered users manual and training
  - 3 Assessed suitability for rollout

- **PHASE 1:** Prep and data request
  - 3 Modelled data & parameters
  - 3 Agreed entitled inventory levels
  - 3 Delivered users manual and training
  - 3 Assessed suitability for rollout

- **PHASE 2a:** Data collection, verification, prioritisation
  - Franchise
  - Prioritize
  - SKU
  - Value stream

- **PHASE 2b:** Define process to monitor sustain & improve

- **PHASE 3:** Pilot model and process

- **PHASE 4a:** Rollout and sustain process

- **PHASE 4b:** Iterative CI targets & projects

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