Simulations for Improved Production Cycles Using a Lean Supply Chain Postponement Strategy

By Jim Curry, Opstat Group Inc.

Background

A supply chain postponement strategy is a valuable lean design concept for the biopharmaceutical industry that has applicability particularly because of the typical multi-stage production processes involved in the conversion of raw materials through to final customer fulfillment. The computer industry has been using this strategy for assembly postponement for many years, such as in the mass customization of computers. The computer industry stores inventory of assemblies, and produces a uniquely configured computer to a customer specification.

Any industry which requires unique labeling of final products such as biopharma does for country specific labels can have significant benefits from geographic postponement, i.e. postponing committing inventory to its final form, by storing inventory of unlabelled products, and then labeling to order or to kanbans for individual country requirements. Like computer assembly, this allows more predictable estimation of aggregate demand across markets.

We have all seen operations that focus on "when will that batch be released?" with production frequently breaking into its schedules to meet a short term requirement. When final country labeled products are produced right from the final production step, it creates many more items in the schedule, and many more inventory items to monitor. Postponement can be a design technique in an optimized supply chain in which all the functions and operations are synchronized.

This presentation uses an actual case study to focus on two things:

1. Postponement as a supply chain design strategy, and how to develop the design process, and
2. The benefit of using simulation to test a new design, including one such as postponement, prior implementing it in practice.

Approach & Methodology

The biopharma industry has some unique challenges to manage. Production campaigning required due to both pre- and post-production changeovers/cleaning activities make scheduling complex. Quality testing and QA documentation add to the lead times for the end-to-end process, which in turn impacts inventory management. In addition, demand variability is increased when every country labeled product is an inventory stock-keeping unit.

This is a case study of a biopharma company in Europe that had some typical symptoms we see in many companies including high inventory levels and deficiencies in service levels, i.e., missing customer orders. The company sold vials of its products through country affiliates. Inventory levels were not known or understood; nor were the number of missed orders. The vials were labeled and packaged

after the batch was created and then shipped to country affiliates. The affiliates had country distribution centers that stored all products sold in the country. Root causes of these symptoms included organizational disconnects, such as country affiliates operating at arms-length for the plant which led to throwing orders "over the wall" to the plant.

Conceptually there is ample evidence that any supply chain operation will benefit from reduced demand variability, consistent production and reduced lead times. However, many lean projects tend to focus only on the high volume products, which usually do not have the complexity and variability of lower volume ones. They also tend to require less effort per unit and cause disruption to the overall supply chain. Two design concepts to keep in mind in a lean improvement effort are:

- One size does not fit all, meaning a solution that fits the high volume products and customers may not fit all products, and
- Keep inventory as far back in the supply chain as possible, i.e., give your operation more flexibility by not committing resources and products to their final form or geography before you need to, and particularly not utilizing constrained resources before you need to.

In this case, there were significant differences in the demand and supply patterns of products in terms of demand variability and lead-time. For each finished country specific product, the *coefficient of variation* of the demand (standard deviation / mean weekly demand), and the supply lead-time plus variability, was computed. These are both drivers of the amount of safety stock required to fulfill customer demand.

The following table shows the comparative differences for the amount of safety stock required.

WEEKS OF SAFETY STOCK REQUIRED FOR 98% SERVICE LEVEL

Lead Time (weeks)	CofV = .5	CofV = 1.0	CofV = 2.0
0	2	3	4
4	2.5	5	9
8	3	6	12
14	5	8	15
26	6	11	21

An analysis of the total business revealed that of approximately 200 finished labeled products, 14 accounted for 66% of demand volume and 26% of the inventory value, and 98 contributed 18% of demand but 63% of inventory value. These typically had higher unit costs and also higher demand

variability. The remaining products consisted of lower volumes and inventory. All three categories were included in a design as follows:

- High volume products with level frequent supply to be produced on a biweekly level cycle
- High cost products with postponement which would produce "white label" product every 4 weeks with kanbans for country labeled stock. The 98 labeled country items were comprised of 21 finished products in vials without the country labels.
- Low volume/low cost products with level supply to be produced twice per year on a regular schedule.

The high cost products with postponement had the most potential for both service improvement and lower inventory. For example, one product was typical of the 21 total in this high cost group. It was sold and labeled for seven countries; on average each labeled item was produced at the plant and supplied to the country warehouses about every six months. The demand in each country was highly variable, so the combination of lead-time and demand variability required high levels of safety stock to be maintained.

On the other hand, the Europe-wide aggregated demand for the product showed lower variability and there was enough volume that a batch of unlabeled vials could be produced every six weeks. The comparative demand variability for the individual countries and the aggregated total is:

COEFFICIENT OF VARIATION

Aggregate Demand All Countries	**.65**
Spain	1.03
Germany	.95
Sweden	1.98
France	2.85
Netherlands	2.28
Italy	1.20
Great Britain	2.11

Simulation results

After the design analysis, all three product set designs were simulated with actual patterns of demand and the production constraints. Adjustments for safety stock were made as needed to address the variability patterns of individual products / countries. It also included the kanban approach for country

specific labeling that included a country quarantine lead-time. Simulation allowed a virtual implementation of the design prior to it physically being implemented.

The simulation showed that implementing postponement of labeling, the company could provide a 97+% service level for their customers for the 21 products included, with a 30% reduction in overall inventory.

Summary

This case study demonstrates the benefits of methodically analyzing the patterns of demand and supply for biopharma supply chains. The operation described is fairly common in our industry, and offers an opportunity for improvement. Specifically, it highlights that there are measureable benefits from using the reduced variability of aggregated demand wherever possible. The aggregated demand combined with shortened supply lead-times and increased consistency in those lead-times, combine to improve the management of the supply chain. The measureable benefits results in higher predictable service levels and reduced safety stock requirements to achieve them.

Jim Curry is CEO of the OpStat Group Inc. He has been a management consultant for large multi-national companies in operations and supply chain improvement since 1987. His clients include companies in the pharmaceutical, chemical, high tech, consumer, and transportation industries. He is also an Adjunct Professor at Fairfield University, teaching graduate courses in supply chain design and lean manufacturing. He serves on the Steering Committee for the ISPE's Operations Management Community of Practice and has written material for ISPE's *Pharmaceutical Engineering.*

The link to the original presentation is on the ISPE Carolina So. Atlantic Chapter website APICS-ISPE Joint Event - Operational Management: Simulations for improved production cycles -- 17 January 2012