POLICY CONTROLS FOR INVENTORY REDUCTION IN A PHARMACEUTICALS COMPANY WITHOUT COMPROMISING SERVICE LEVELS

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Summary:
This thesis investigates inventory management policies for the flagship antibiotic brand of a top global pharmaceuticals manufacturer, with the objective of reducing inventory levels and relevant costs, without affecting levels of service. A Monte Carlo simulation framework is developed in Microsoft Excel, and used to evaluate the impact of alternative management policies on average inventory levels and total inventory cost at the distribution end of the supply chain, while maintaining service levels at, or within 1% range of the established 98%.

About the authors:
M. Shahid Bashir holds degrees of Bachelor of Science, Mechanical Engineering (GIKI-2001) and MBA (LUMS-2007) from Pakistan. Before joining this program, he was heading operations of an electrical transformers manufacturing company that manufactures and supplies distribution equipment to the national utility company. Prior to that, he worked as project lead for a bio-chemical company, involved in the production and export of ethyl alcohol. His career interests are operations, procurement and strategic management.

Melissa Medford holds an undergraduate Bachelor of Science degree in Hotel Management, conferred by the University of the West Indies, Mona. Jamaica. Her interest in Supply Chain Management developed over the last six years, in her role as Country Manager for the Trinidad and Tobago unit of an intermediary Central American entity, which sources and supplies chemical raw materials to a range of manufacturing industries. Her decision to pursue the Master of Science in Supply Chain Management is inspired by a desire to build knowledge in this emerging and innovative field that is swiftly gaining prominence.

KEY INSIGHTS

1. When inventory reduction is the main objective of inventory management (IM), it is insufficient to only lower average unit inventory levels. The "best" policy for managing inventories results from a favorable combination of target service levels and low total relevant costs (TRC).
2. In balancing the trade-off between inventory holding and obsolescence costs vs. penalty costs of shortage, classification based on cost criteria is useful, to devote inventory management efforts to groups of SKUs.
3. It is worthwhile to consider demand distribution characteristics in IM policy selection. Approximation techniques can be used to derive policy parameters that lead to TRC reduction, for a wider range of distributions than traditional models.

Introduction

The pharmaceuticals industry is characterized by high service levels, due to the critical function of many of its life-saving products. Demand is stochastic as the need for these drugs cannot be easily anticipated. Inventories must therefore be managed to balance between costs of excess stocks and related obsolescence, and penalty costs of shortage or stock-outs.

In the antibacterial market, there is a high level of unmet need and growing clinical demand for innovative and novel drugs. The Food and Drug Administration has incentivized companies since 2012, to engage in increased R&D activities and launch more products to fill this need. (US FDA Safety and Innovation Act, 2012). The high costs of R&D, means that companies must look for cost saving opportunities so that working capital can be released. As key antibacterial brands also face intensified generic competition (Business Insights, 2011), companies must look for ways to operate more efficiently, to capture the modest growth anticipated from emerging markets.

Inventory management seeks selection of the "right" parameters to guide on when to order, how much to order and how much buffer stock to hold, for fulfilling as much uncertain demand as is feasible. Inventory policies vary in how these parameters are determined and influence cost. This study evaluates the impact of five traditional policies on service levels, inventory levels and inventory costs, for PharmoGlobin's key antibacterial brand; PHARMIN. Since a number of PHARMIN SKUs are found not to follow normal distributions of demand, an approximation technique is applied from the literature, as an alternative approach to derive the parameters of one of these policies.

Literature Review

Understanding the relationship between service levels, safety stocks and traditional inventory management policies is key in the development of this study. A revision of both continuous and periodic review systems in the (R,S), (s,Q), (s,S) and hybrid (R,s,S) and (R,s,Q) policies (Silver, Pyke and Peterson, 1998), is undertaken to ascertain the key parameters for each policy, and how they are derived. Common approaches to safety stock calculations under assumptions of variability in demand, in supply and a combination of both, are also reviewed, since they are used in establishing the base case for inventory management practices at PharmoGlobin's Asia-Pacific (APAC) distribution echelon, where the study is focused.

Traditional safety stock calculations, are based on the assumption of normally distributed demand characteristics. Of the PHARMIN SKUs evaluated in the study, only 8% support the hypothesis that their demand is normally distributed. (Ehrhardt, 1979) introduces a robust approach that does not require specifying the form of the demand distribution, to derive policy parameters, for the (s,S) model. The Power Approximation is proven effective for selecting parameters that yield total inventory cost within 1% of optimality, and is therefore integrated into the thesis. Only mean and variance of demand over lead time are required for computation. In his work Ehrhardt acknowledges that the efficacy of this approach is reduced in instances where demand variance is small and penalty costs low. This is evident in the relative performance of this policy when evaluated against the others in this study.

The work of (Teunter, Babai and Syntetos, 2009), promotes an alternative approach for classification ranking to assign distinct levels of service or inventory management techniques to groups of SKUs. The cost criterion method outperforms more traditional spend analysis ranking methods, when applied with the objective of inventory reduction. The approach attributes higher priority to SKUs that face higher shortage costs and lower holding costs, so that higher levels of service and inventory levels are reserved for those SKUs, at ultimately reduced holding and obsolescence costs.

Methodology

Data collection was engaged from a mix of primary and secondary sources. A review of public company annual financial reports led to the development of an interview questionnaire. Following the interview with key brand management personnel, a process map of the existing supply chain system materialized which led to the design of data request templates for filling gaps that would be needed for understanding the existing base case and building on the study.

The cost criterion ranking of Teunter, et al, was applied to 38 of the 50 SKUs received, 19 each from two dosage concentration groups. In total, SKUs from six concentration groups were received, with the 625mg and 1000mg categories most populated, comprising 19 SKUs each. Since none of the categories was highlighted as any more problematic than the others during the initial interview, the sample was selected from those two categories which provided the widest range of SKUs.

12 SKUs were taken forward from this ranking, based on completeness of available data. Statistical tests, in the form of Chi Square tests and QQ plots were carried out on the distributions of demand to examine the hypothesis that these distributions were normal. At this point, an evaluation of the safety stock determination practices used by PharmoGlobin in the management of PHARMIN, was conducted. This served to ascertain whether traditional methods, operative under assumptions of normal demand might be in use where demand characteristics are proving to be otherwise distributed.

Three different buffer levels of safety stock were found to be in effect at the distribution echelon of the PHARMIN supply chain. These were calculated and graphed against month-end inventory balances at both the company warehouse and distributor warehouses over a twelve-month period, for 5 of the 12 SKUs. Since 3 out of the 5 SKUs showed consistently higher stock levels than safety stock limits, month by month, these graphs were brought to the attention of the sponsor. One of these; SKU VN-097, was confirmed by the company to be regarded as an overstock problem.

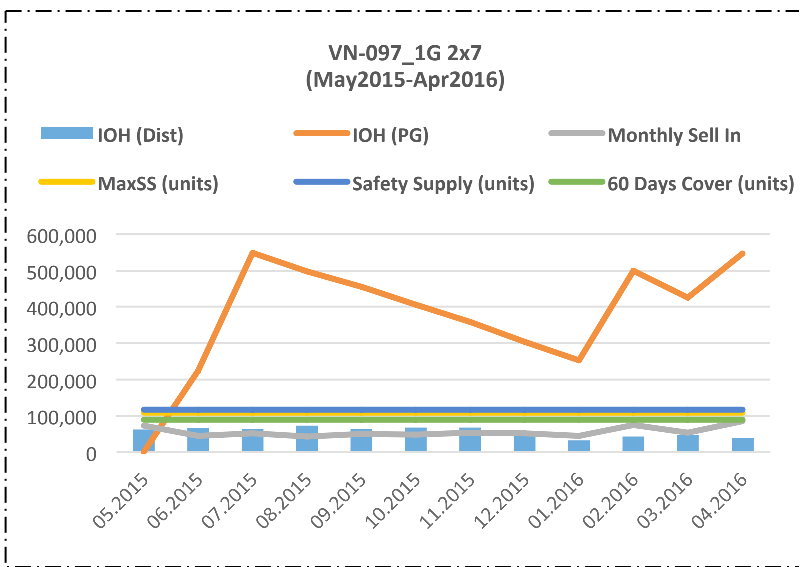

Figure 1: SKU VN-097 Distribution Warehouse Stocks against Safety Stocks

Simulation models were designed in Microsoft Excel to replicate five inventory management policies identified for evaluation; (R,S) as the base case in existence, (s,Q), (s,S), (R,s,S) and (R,s,Q). Model inputs were directly extracted from the data available for each SKU. Demand distributions, lead times and costs were the key inputs. Standard costs were provided per SKU while shortage/penalty costs were computed as the lost contribution margin for every missed sale opportunity.

Simulation output included the service levels, average inventory levels and total relevant cost returned by each policy, as a combination of shortage and holding costs. These were analyzed across the five SKUs for proposing recommendations to the sponsor company on policy selection towards inventory and related cost reduction.

Results

The output of the simulation models was tabulated, with a "winner" policy selected for each of the five SKUs on the basis of a combination of lowest total relevant cost and highest service level. Figure 2 below presents the summary table which shows the (s,Q) policy as the winner for 4 out of the 5 SKUs. The total cost output of the "winner" policy is also compared to the (R,S) policy as the system in effect at PharmoGlobin's distribution hubs, to demonstrate the potential savings of the switch in policy across the SKUs.

The savings are significantly higher (49% and 41%) for the 2 SKUs ranked highest out of the 5, in order of priority in the cost criterion ranking exercise. Table 2 lists the SKUs in descending order in which they were ranked.

	Service Level (winner)	Service Level	Average Inventory	TRC	% TRC savings over (R,S) base
PH-380	(s,Q)	99.00%	(R,s,Q)	(s,Q)	49%
VN-097	(s,Q)	99.65%	(R,s,Q)	(s,Q)	41%
SG-169	(R,S)	96.30%	(R,s,Q)	(R,S)	-
PH-057	(s,Q)	97.65%	(R,s,Q)	(s,Q)	18%
SG-052	(s,Q)	96.59%	(R,s,Q)	(R,s,Q)	8%

It is noteworthy that none of the "winner" policies actually returned the lowest units of simulated inventory levels. The (R,s,Q) simulation model consistently produced the lowest levels of inventory units for all five SKUs. This policy also returned the lowest total relevant cost for one SKU; SG-052. However, the service level was much lower than the target 98% at 91.86% in this case. The winner (s,Q) policy selected therefore actually represented a combination of the second lowest total cost, and highest service level (96.59%) for this SKU, since on service level, there is no room for compromise. In general, the service levels returned by the (R,s,Q) policy were among the lowest of the simulation output.

Conclusions

The findings of this study provide a conclusive answer to the question it sets out to address. With the objective of inventory and related cost reduction, it is worthwhile to evaluate alternative inventory management policies. As in four out of the five cases demonstrated in the study, a change in inventory control policy from the existing (R,S) to the (s,Q) system could in fact lower inventory costs without compromising established service levels. For higher ranked SKUs, the (s,Q) policy is a clear winner for achieving this objective. As seen with the output of the (R,s,Q) policy, a reduction in inventory units alone, without considering the impact on service level is not guaranteed to achieve total cost reduction.

The fact that the SKUs represented varied distributions of demand did not significantly impact winning policy selection. The total cost results of the (s,S) policy, as the only policy for which a non-traditional approximation method was introduced for computing parameters of (s) and (S), were higher than the "winner" policy in all instances. Low penalty cost and relatively low demand variability in these cases may have impacted the efficacy of these results. Relative to the total cost output of extant (R,S) policy however, lower total cost performance of this policy for 3 out of the 5 SKUs evaluated, at higher service levels, suggests that there is value in considering demand distribution characteristics in parameter determination for inventory and related cost reduction.

The framework used to develop the policy simulations in this thesis can be extended for future evaluation of new policies and additional SKUs, as input parameters are readily available from company records.

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