



MIT SCALE RESEARCH REPORT

The MIT Global Supply Chain and Logistics Excellence (SCALE) Network is an international alliance of leading-edge research and education centers, dedicated to the development and dissemination of global innovation in supply chain and logistics.

The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

For more information, contact
MIT Global SCALE Network

Postal Address:
Massachusetts Institute of Technology 77
Massachusetts Avenue, Cambridge, MA 02139 (USA)

Location:
Building E40, Room 267
1 Amherst St.

Access:
Tel: +1 617-253-5320
Fax: +1 617-253-4560

Email: scale@mit.edu
Website: scale.mit.edu

Research Report: ZLC-2011-14
Modeling an Efficient Planning Methodology in Pharmaceutical Supply Chain
Susan E Hanson and Yunan He

For Full Thesis Version Please Contact:

Marta Romero

ZLOG Director

Zaragoza Logistics Center (ZLC) Edificio

Náyade 5, C/Bari 55 – PLAZA 50197

Zaragoza, SPAIN

Email: mromero@zlc.edu.es

Telephone: +34 976 077 605

Modeling an Efficient Planning Methodology in Pharmaceutical Supply Chain

By Susan E Hanson and Yunan He
Thesis Advisors: David Gonsalvez and Beste Kucukyazici

Summary:

This thesis investigates how to reduce manual efforts in schedule and production planning without affecting planning accuracy by developing an efficient methodology. The planning process of a pharmaceutical company is analyzed by identifying qualitative exceptions and quantifying risk measurement. A simulation model is designed to compare the differences in labor time and inventory control between the current and new planning processes.



Susan E Hanson graduated from the ZLOG program in 2011. She received her B.S. in Industrial Engineering from Bradley University in Peoria, Illinois in 2006.



Yunan He graduated from the ZLOG program in 2011. He received his M.Sc. in Structural Engineering and Mechanics from the University of Edinburgh in the UK in 2005 and his B.Eng. from Dalian University of Technology in China in 2004.

Key insights:

1. Manual efforts are often necessary in system-based planning due to the inaccuracy caused by certain system constraints.
2. Manual effort can be reduced without affecting planning accuracy by clustering makeups with similar characteristics and considering a complete qualitative analysis.

Introduction

Demand and supply planning are critical elements in the success of any company. Only with proper planning techniques can companies ensure that they produce and distribute products effectively, such that their customers receive the right product at the right time in the desired quantity. Without proper planning procedures, companies risk overstocking and thus reducing their profitability due to excess production, transportation, and

inventory. Alternatively, a stockout can reduce both current and future sales, reducing customer goodwill. Although planning affects the profitability and livelihood of all companies, the consequences of poor planning can be especially severe in the pharmaceutical industry when the health and well-being of customers are at stake.

Globalization and information technology are cornerstones in many successful strategies; these have led companies to use more sophisticated software packages to generate demand forecasts and material requirements schedules. Despite technological advances, manual input or adjustments are often needed to incorporate qualitative elements that cannot be easily integrated into systematic calculations. As companies convert from old planning processes to newer, system-driven processes, they often manually monitor calculations to mitigate the risks of system errors and failures. However as the systems stabilize, these risk mitigation processes

remain untouched, causing unnecessary work and reducing efficiency.

In an era of economic downturn, many companies are using lean techniques to identify waste in their current processes and to make adjustments to improve overall efficiency and thus profitability. One area for improvement is in demand planning. Many companies struggle with normalizing their planning processes- eliminating wasteful procedures while ensuring that quality output is maintained. This creates opportunities for research and improvement, ultimately improving profitability and efficiency within a company.

Our thesis focused on three main research targets. Firstly, we segmented the product portfolio into three groups based on planning needs: those that always require manual planning, those that can be planned only with the system, and those that can be planned with the system when they are within control mechanisms. The second research target was to identify adaptive and responsive control mechanisms that would further specify which products need to be manually planned. Finally, we established performance metrics to ensure that the reduction of planning time did not result from a reduction in planning quality.

To explore these improvement opportunities and increase efficiencies, we studied the regional planning group of a large, multinational pharmaceutical company. We used a four phased approach, as shown in **Error! Reference source not found.** We began with a survey of employees to ensure that we fully understood the problem, current processes, and constraints. We also gathered employee input on critical exceptions and other important factors in the process. We collected product data to create groups of similar products that we could model in an Arena simulation to determine time requirements for the planning process as well as to anticipate the negative consequences of our methodology. After validating our model, we performed a sensitivity analysis to ensure that our results were robust. Finally after we consolidated our results, we drew conclusions and made recommendations for future study. Details of each step can be found in the subsequent sections.



Figure 1: Methodology

Industry Case

Our case study focuses on a large, multinational pharmaceutical company. Currently a small regional planning group is responsible for materials replenishment and production planning within the company. Since 2003, the company has been using an SAP software system to create demand forecasts and replenishment schedules for 3500 products in 22 different Western European countries. As a risk mitigation technique implemented during the SAP implementation, the regional planners began manually reviewing each schedule for their portfolio, a process they have maintained since the software's initial implementation. Currently they are incorporating more countries into the SAP system, which will expand their portfolio of products from 3500 to 5000. To become a more lean and profitable planning organization, they want to reevaluate their planning process to ensure that they only focus their efforts on manually reviewing schedules when it adds value.

Survey

We surveyed and interviewed various employees from the company in order to better understand the planning process. Currently, planning is executed on a monthly basis. Planning takes place in stages, where the primary groups responsible must review and approve the data within a specified amount of time in order for the next group to begin their authorizations.

In our interviews with and observations of the regional planners, we found that there were several key factors that helped identify products that must always be manually reviewed: common or combined makeups, contract setups, switches, and makeups from certain high-risk countries. In addition to these exceptions, the regional planners

also focused their attention on high-risk schedules. Certain countries used processes that often created complications within the system. Besides providing guidance on the exceptional makeups, the regional planners also provided insights into key measurable criteria that also caused makeups to require manual planning: forecast accuracy, forecast tracking signal, and coverage days of inventory.

During our initial interviews with regional planners, we gleaned that there were several qualitative aspects of makeups within a country that created higher risk for systematic planning, as well as special planning challenges (such as packaging or more complex supply chains) requiring more attention from planners. Based on these interviews, we created a survey to capture some of the qualitative risk, focusing on six key areas: forecast accuracy, sales volume, sales volatility, sales value, strategic importance, and special exceptions. Based on feedback from the company, the results were analyzed and the risk of each country was ranked and quantified. In addition to capturing information about the countries currently planned with SAP, the survey also asked the planners for their opinions on the countries that would soon be incorporated into the SAP system. Based on their knowledge of the markets, we estimated the risk scores for the future countries by asking them to indicate which of the current countries they most expected the new countries to resemble in a steady-state environment.

Modeling

Based on our initial insights gleaned during the survey phase, we developed a conceptual approach to separate makeups that were planned accurately by the system from those that required manual review or planning.

We began with a qualitative analysis- separating the makeups that needed manual review due to specific planning scenarios, namely switches, combined makeups, and toll or contract setups. Because of the complexity of the scenarios as well as the data available to identify them, we determined that all makeups within these three groups needed to be reviewed manually.

Next we examined the country risk score of the makeups. We decided that a country risk score exceeding 0.75 (on a scale of 0 to 1) would qualify a country as high risk and all makeups for that country would be planned manually. The risk scores of 3 of the 24 countries exceeded this threshold. Although this score was reached somewhat subjectively, the company agreed that three countries was a reasonable number to plan manually.

In total, makeups falling into one of these four qualitative categories represent over 50% of the portfolio. Although makeups may fit more than one qualitative criterion, they were only counted in the first criterion by which they were identified.

After identifying the qualitative exceptions, we began a more quantitative analysis. This quantitative analysis was designed to capture both the long and short-term impact of data on the remaining makeups. Based on the input from the planning experts and statistical analysis, five key risk factors were identified and quantified in order to evaluate the overall risk of all makeups: forecast accuracy; forecast tracking signal; coverage days of inventory; whether it is a strategic product or not; and country risk. We calculated a risk score to incorporate both quantitative and qualitative factors from historical data. The score used historical data (2 years when available) to establish the overall risk in the stability and predictability of the makeup.

If the risk score was poor, the makeups were again sent to manual review, while the makeups with a very good risk score were planned only by the system. The makeups that remained needed further calculations to determine the level of planning required, so we calculated three control factors: forecast accuracy; forecast tracking signal; and coverage days of inventory. These control factors were designed to focus attention on the recent behavior of the makeups rather than on their longer term performance. If the makeups were out of control, they again were manually reviewed, while those in control were planned only by the system.

In order to test our model and control limits as well as perform sensitivity analysis, we decided to use simulation with Arena. To accomplish this, we needed to summarize the factors and variables

described into statistical distributions. To arrive at more concise distributions, we used clustering to further separate the makeups that would pass through the control limits.

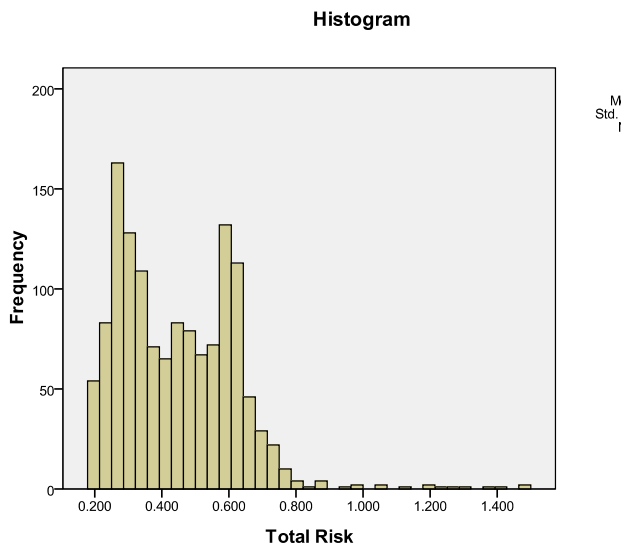


Figure 2: Risk Score Histogram

Conclusions

Firstly, our simulation scenarios helped establish an estimate of the additional planning time required when additional countries are incorporated into the SAP system. Our As-is model indicated that the future number of makeups with the same qualitative groups would yield a planning time of 142.4 hours, while the revised qualitative groups would need 130.4 hrs of planning time. Based on this, we estimate a 35-50% increase in manual planning time, depending on the distribution of new makeups among the qualitative groups in the As-is model (switch, combined makeup, other).

We also measured the percentage of time saved with the introduction of our methodology. With the current distribution of makeups among the qualitative groups, using 80% control limits with our methodology resulted on average in a 5.7% savings in total planning time, while 90% and 99% control limits yielded a 6.8% and 8.3% time savings respectively.

Unfortunately, we could not accurately quantify the risk at which these savings were achieved. The percentages of makeups with poor inventory control (stockouts or excessively high levels) were more dependent on the level of increased variability and not on the control limits. For example, the percentages of stockouts and high inventory levels are greater for scenario 6 than they are for scenarios 4 or 5. This pattern is true of all scenarios that assumed a 100% increase in variability.

Based on these observations, we believe that the answer to saving more planning time lies in re-examining the qualitative exceptions. Switch makeups alone account for 33-45% of the total planning time (depending on the scenario). With only four qualitative categories (switch, combined makeup, toll/contract, and high risk country), the qualitative makeups represent just over 50% of the makeups, but 73%-83% of the time required to plan. Without reducing either the number of qualitative exceptions or the time it takes to plan them, the methodology will not provide significant time savings.

Also in order to justify the time and cost required to develop a systematic tool to execute the methodology, we believe the planning time savings would need to be greater. In addition we recommend further analysis on the consequences of not manually reviewing a schedule. Time saved on the planning end may not result in overall savings for the company unless quality schedules are ensured.

With enhanced scenarios and more analysis on the consequences of not reviewing manually, we believe the qualitative analysis should capture more of the problem makeups and increase the likelihood that makeups continuing through the control limits will be in control, and thus, not require manual review.