SWOT Analysis of a Simulation Based Supply Chain Model

Nora Murphy[1], Graduate Student
University of Massachusetts Amherst
noramurphy@umass.edu
Amherst, 01002 MA. USA

Manvi Deshlahara[2], Bachelor of Commerce
Kothari College of Management Science
manvi.deshlahara@yahoo.com
Indore, 452001 MP, India

Devashish Dixit[3], Graduate Student
University of Massachusetts Amherst
dixit.devashish2805@gmail.com
Amherst, 01002 MA, USA

Abstract: **The paper reflects efficient SWOT analysis for a Supply Chain Network and market based decision making for a simulation based environment. Simulation of supply chain models is key tool to identify the shortcomings of supply chain models which appear highly effective on paper but need continuous monitoring in real time. For example the *continuous review models, EOQ models* and *newsvendor models.* Evolved from time to time and updated through cut-throat technological advancements, supply chain design is still a big problem faced by big companies with brand equity and even established consumer audience. Hence a SWOT analysis for supply chain is an effective method to choose various elements of elimination and inclusion in our supply chain network design. We will show how an integrated informational feedback at various levels helps in increasing the overall profit through a supply chain.**

Key terms: QR model, Re-order point, SWOT, lost demand, WIP.

INTRODUCTION

A factory in a hypothetical region X of a hypothetical continent of Mura has to be equipped with an efficient supply chain mode. Simulation was through The Supply Chain Simulation facility which was purchased for $60 online. The factory manufactures chemicals which are sold and shipped in drums. A drum of chemical is sold for $1650 and the shipping cost from the factory to the ware house is $16000 per truck regardless of the number of drums. The maximum capacity of plant is 20 drums per day and for a truck, 200 drums per run. Extra capacity can be bought and inventory holding costs are $150/drum/year. It takes 7 days to ship an order from the factory to the warehouse and the market demand is patterned but not continuous. The operation is designed to start at day 730 and end at day 1460 that is two years and the demand on day 1460 will come to zero. After designing a supply chain for the given parameters we found a few shortcomings and a few strengths in the network which we will highlight.

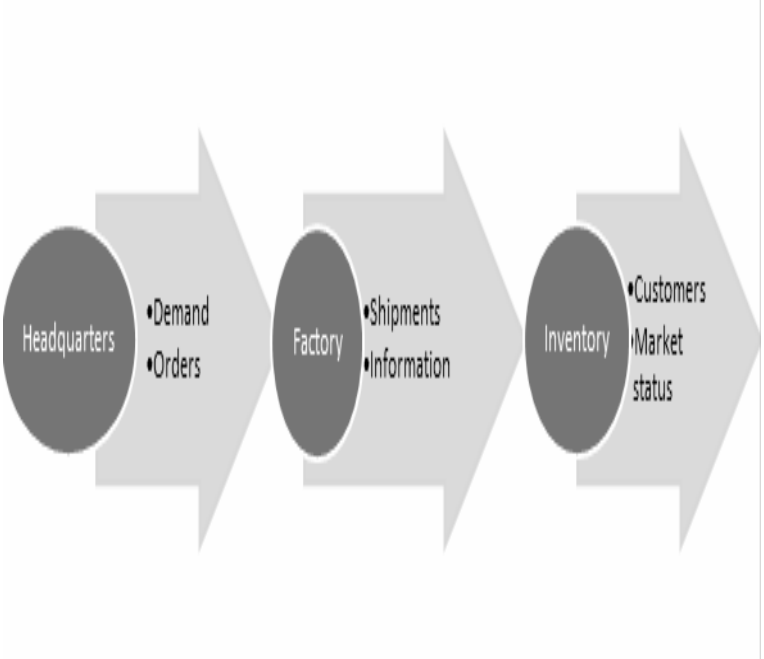

Figure 1: Relevant flow of materials and information.

PRIMARY DATA SOURCE

The data is primary and is from the simulation which ran for one week. In the simulation we completed two years of supply chain management and four years in total as the data for two years was already provided. One day in simulation was equivalent to 14 minutes in real time and 104 days in simulation equaled 1 real day. The data available to us is namely, cash profile, shipment status, inventory status, demand profile, WIP (work in progress) and lost demand. As the data is huge for four years of simulation we will use graphs to display the gist of the operations.

- *Demand Profile*:Demand shows regular patterns on yearly basis but is vulnerable to market status and competitors. Although this sort of demand is considered to be stable, we cannot completely predict the fragmentation and hence a minimum inventory level has to be maintained.

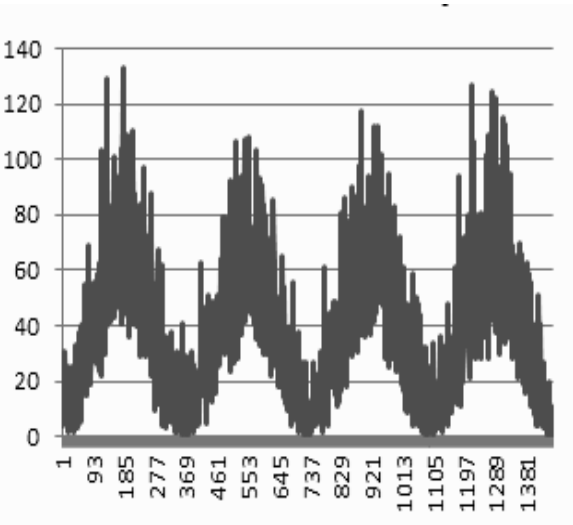

Figure 2: Demand Patterns (units vs days)

- *Shipment Profile*: The valleys and peaks are a result of the lead times in manufacturing and shipment. A firm will not want to ship 20 units when it can ship 200 units with a lead time of 5 days the shipping cost will outweigh the profit. The peaks show that the batch of a particular order is on its way to the warehouse and the valleys show that the transport is waiting for the factory to manufacture the order. Any time in a fiscal year the decision of shipment and batch size also depends on the Benefit- Cost Analysis so as to find out the net profit in shipping and not shipping.

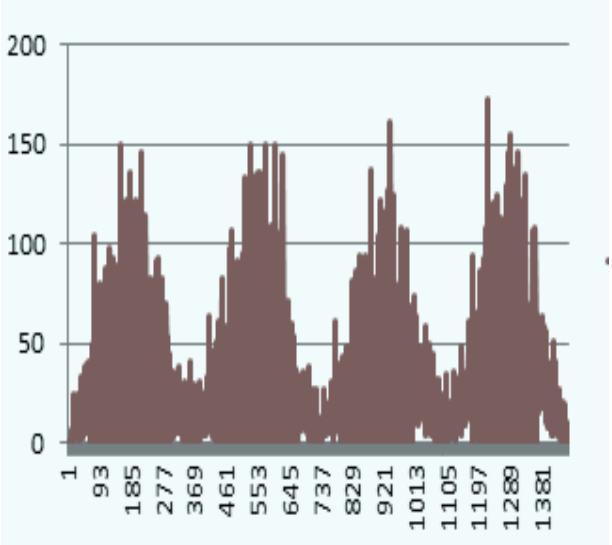

Figure 3: Shipments on daily basis (units vs Days)

- *Inventory Status*: Holding up a huge inventory is considered bad supply chain practice in recent times. Although, there has to be a minimum amount of inventory to suffice for the uncertain market regimes and factors like a natural disaster.

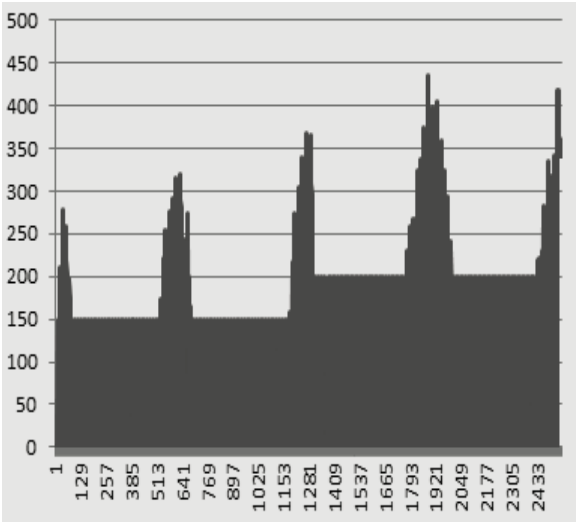

Figure 4: Inventory Status (units vs days)

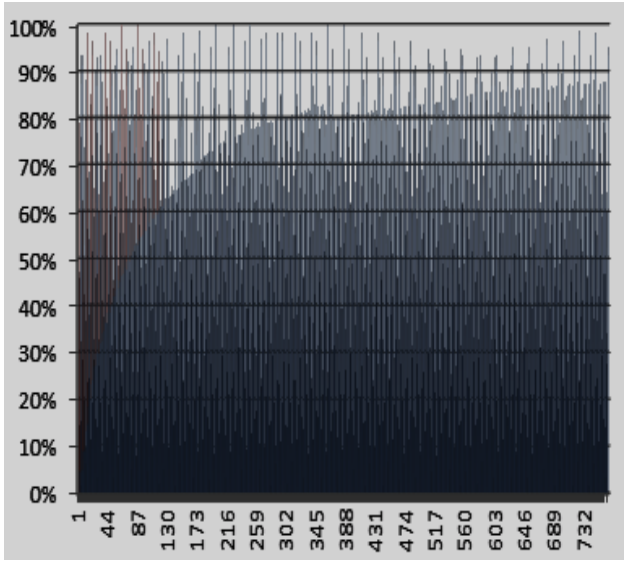

Figure 5: WIP as percentage of Max (200 units) vs days

The graph displays a regular increase in the amount of inventory and the major reason behind such an observation in real market is due to the Bullwhip effect. The uncertainty at the bottom level amplifies as it reaches to the top level hence making the manufacturer to produce more safety stock or very less of it that the actual requirement.

- *Manufacturing Profile, WIP*: The minimum order pint for the factory to keep working is mostly 750 units during most of the year. This means that if the sum of on the way units through trucks and that in storage in inventory is less than 750 the factory will continue to manufacture.

- *Lost Demand Detail*: Due to lead times and lack of storage to fulfil an order the customer orders products form a different firm. This lost demand should be treated as a loss as it is potential money which can be earned through corrected efficient chain planning. Lost demand leads to loss of hold over the market and brand equity.

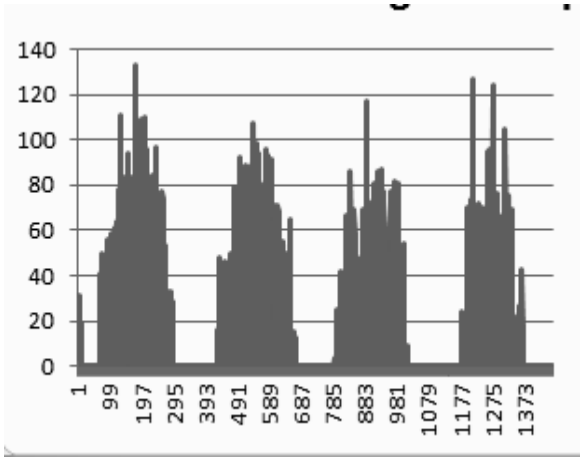

Figure 6: Lost demand (units vs days)

- *Cash Balance*:

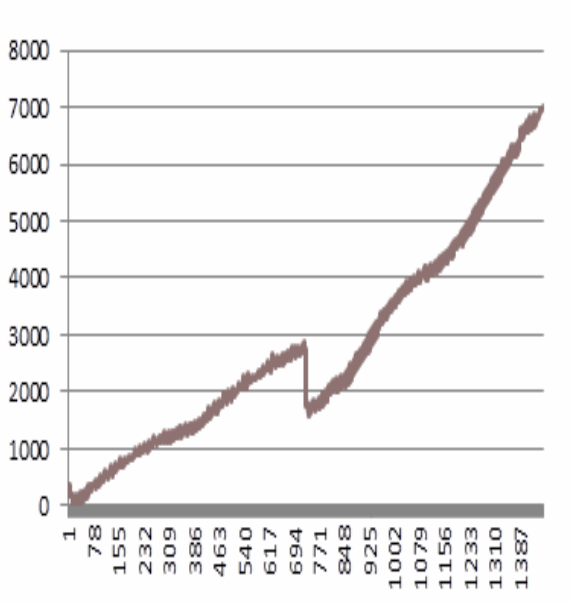

Figure 7: Cash ($) vs Days

It is an integral part of supply chain various elements are work together to increase the net profit of the firm and hence commenting on the cash flow trends is vital and necessary. The highest value is 6,987,045.24 $.

SCOPE FOR SWOT

From the above observations we can infer that there are many shortcomings and strengths that this supply chain model has to offer. As from the graphs we can clearly see that the inventory at the end date is high and hence there has been lack of proper demand forecast owing to the waste pile up. After the end date the demand turns zero so ideally to increase the profit we have to get rid of the inventory and any other loop holes in the plan. Similarly we will be looking at SWOT for different elements of the supply chain.

SWOT ANALYSIS TABLE

STRENGTHS	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
➢ **Financial back up** ➢ **Safety stock** ➢ **Effective initial planning** ➢ **Good company-vendor relations** ➢ **Integrated re-order point** ➢ **Effective demand forecast**	➢ **Not utilizing capacity expansion power** ➢ **High Lead Time** ➢ **Poor allocation of factory or warehouse** ➢ **Service level**	➢ **Installing new technology** ➢ **Increasing the capacity** ➢ **Brand equity** ➢ **Prior market experience**	➢ **Retailer bankruptcy** ➢ **Retailer bankruptcy** ➢ **Fragmented demand** ➢ **Left up inventory at the end of simulation**

STRENGTHS OF SUPPLY CHAIN

- *Financial back up*: The firm has been provided with a good financial starting budget of $ 500,000.00. Having a good financial back up helps in employing a high tech supply chain network design team. It also helps in applying the decisions and changes calculated by the team of experts.

- *Safety stock*: High safety stock hold ups is necessary for big manufacturers and helps in meeting the uncertain demand. As the demand forecast is only correct for a 50% of chances, a minimum amount of inventory is required and the correct amount is calculated based on various models of supply chain. Figure 4 shows how for most of the period the minimum inventory remains more than 150 units which was calculated through Q,R model or the continuous review model.

- *Effective initial planning*: The calculations based on the Q,R model where we calculated the order quantity and order point proved to be efficient as the demand profile and the shipment profile are similar.

- *Good company-vendor relations*: We can infer from the Figure 2 and Figure 6 that although some demand is not met and lost during the course of four years but the future demand is not affected by the lost demand. Hence, keeping a good relation with vendor a vital element of strengths column.

- *Integrated re-order point*: Re- order pint was changed two times in the course of the simulation. It was kept at 350 units, 750 units and 350 units in succession with respect to the demand profile in Figure2. Re-order point is the number of units in inventory below which the factory will always keep manufacturing.

- *Effective demand forecast*: Unlikely with the real practice where the demand forecast is usually wrong, it seems that the team was able to efficiently forecast the customer demand. We had an average annual demand of 70 units.

WEAKNESSES OF SUPPLY CHAIN

- *Not utilizing capacity expansion power*: Provided the budget we expanded our capacity from 20 units per day to 40 units per day. But from Figure 6 we can clearly see that there are a lot of lost demands which are following a pattern. This means there is a particular demand which will always be present at that time interval and hence increasing capacity would have been a profitable move.

- *High Lead Time*: It takes 7 days for a manufactured batch of products to reach the warehouse from the factory. This high lead time leads to lost demand and more uncertainty at the top level.

- *Poor allocation of factory or warehouse*: The high lead time is due to the long distance between the factory and warehouse. The transport cost hence being very high as 15,000$. The firm can either use a third party warehousing to cut short the expenses or can employ latest inventory sensors which update the headquarters about each and every unit being sold and hence can help in an instantaneous planning and hence zero the waste.

- *Service level*: A high service level should be taken into account if the firm budget allows so. Service levels may vary from 0.4 to 0.99 and higher the value better is the service. Better service in the context of a supply chain is when mostly all the demand is met. Hence, the service level is not optimum as seen from the lost demand Figure 6.

OPPORTUNITIES FOR SUPPLY CHAIN

- *Installing new technology*: New software to control inventory are very effective in a way that they keep the system updated with the current level of inventory like on in Wall Mart. This helps in increasing the service level as the inventory can be refilled as soon as there is a void.

- *Increasing the capacity*: Extra capacity to meet the lost demand. Though a good benefit –cost analysis must be employed.

- *Brand equity*: Good hold over the market can be helpful for a supply chin design as the changes and decisions can be applied with a lot of certainty.

- *Prior market experience*: Experience of market is an invaluable asset to possess and

gives an advantage over the new competitors.

THREATS TO SUPPLY CHAIN

- *Retailer bankruptcy*: Retailer's financial status affects the order size and future demand a lot. If a retailer has gone bankrupt then the orders can be affected and large inventory pile up is observed with high holding storage cost.

- *High Inventory*: High amount of inventory incurs high holding cost and more damage probability. But high inventory is necessary for keeping a high service level and hence this is a potential risk which the companies have to take.

- *Fragmented demand*: Demand follows a pattern but is not continuous. There are few days where the demand is zero.

- *Left up inventory at the end of simulation*: The simulation was designed to end after the period of four years and the demand after the completion of the simulation will turn to zero. The technology will become obsolete and hence we need to get rid of the entire inventory. Hence, production must be stopped at a particular time where the demand can be met through the available inventory and the storage does not go to waste after the completion of the simulation. Figure 4 should have had a zero inventory after day 1460.

CONCLUSION

SWOT analysis of the supply chain in the X region shows that lack of information exchange in a supply chain is a key drawbackwhich results in inefficient methodology for designing a supply chain network. Continuous review is required to forecast the parameters correctly. Supply chain counts for a major share of a company's financial status and hence assessment through SWOT can help us focus on our strengths and work on the weaknesses. Continuous review of the supply chain network is the only method to cut the wastage and expenses.

References:

[1.] Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E. Designing and Managing the Supply Chain, 3rd Edition, McGraw-Hill/Irwin, 2007

[2.] Graves, S. and De Kok, A. Handbooks in Operations Research and Management Science: Supply Chain Management: Design, Coordination and Operation, Elsevier, 2003.

[3.] Chopra, S. and Meindl, P. Supply Chain Management, Prentice Hall, 2012.

[4.] Hopp, W.J. and Spearman, M.L. Factory Physics, Mc-Graw Hill, 2000.

[5.] Simchi-Levi, D.; Chen, X. and Bramel, J. The Logic of Logistics, 2nd edition, Springer, 2005.

[6.] Shapiro, J. Modeling the Supply Chain, Duxbury, 2001.

[7.] Peter, Donnelly. A Preface to Marketing Management, 14th Edition, McGraw-Hill/Irwin.