



Advanced Principles of Supply Chain Management

Beer Game

3th March 2008

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CONTENT:

- 1. Introduction**
- 2. Playing the Beer Game**
- 3. Recap of the Game**
- 4. Computer Game Part 1**
- 5. Recap of the Computer Game Part 1**
- 6. Computer Game Part 2**
- 7. Recap of the Computer Game Part 2**
- 8. Supply Chain Management**
- 9. Bullwhip Effect**
- 10. Beer vs iPod**
- 11. Conclusion**
- 12. References**

1. Introduction

The Beer Game is a logistics game created by a group of professors at Massachusetts Institute of Technology (MIT) Sloan School of Management in early 1960's to demonstrate a number of key principles of Supply Chain Management.

Throughout this report a range of Beer Game variations will be played to gain awareness of patterns in the Supply Chain Management. However it is important to note that certain management decisions creates patterns in the supply chain that do not necessarily guarantee the results expected.

Several System Dynamics have been researched and explored through the various Beer Games and compared to the actual Supply Chain Market.

2. Playing the Beer Game

To develop a basic assessment of the Supply Chain, four teams consisting of approximately five students played the Beer Game with one another. Each team was assigned a business in the Supply Chain representing one of the following:

- Retailer
- Wholesaler
- Distributor
- Manufacturer

The main aim of the team is to minimize the cost created by an inventory and backlog. Each team is responsible for the reduction of costs incurred by its assigned company and not of the whole Supply Chain.

The teams are only permitted to communicate to one another through the use of numbers that indicates their desired order while all other communication are prohibited.

3. Recap of the Game

The short time frame combined with limited knowledge of the Supply Chain Management creates difficulties for each team to develop a successful strategy. The manufacturing team completed the game with a staggering inventory due to the inconsistent orders which at times ranged from 0 to 40 units.

Following completion of the game the teams assessed the overall cost of the customers orders. However, the manufacturing team later realised that the customers orders varied marginally between 4 to 8 units in comparison to their own orders which differed from 0 to 40 units.

This experiment illustrates that a slight change down-stream (customer) of the Supply Chain has a much stronger effect up-stream (manufacturer).

4. Computer Game Part 1

The research obtained in the previous experiment was later used in a computer version of the Beer Game as found in this website

http://forio.com/simulation/nearbeer/index.htm?FD_action=start_trial to confirm the theories that had been developed previously.

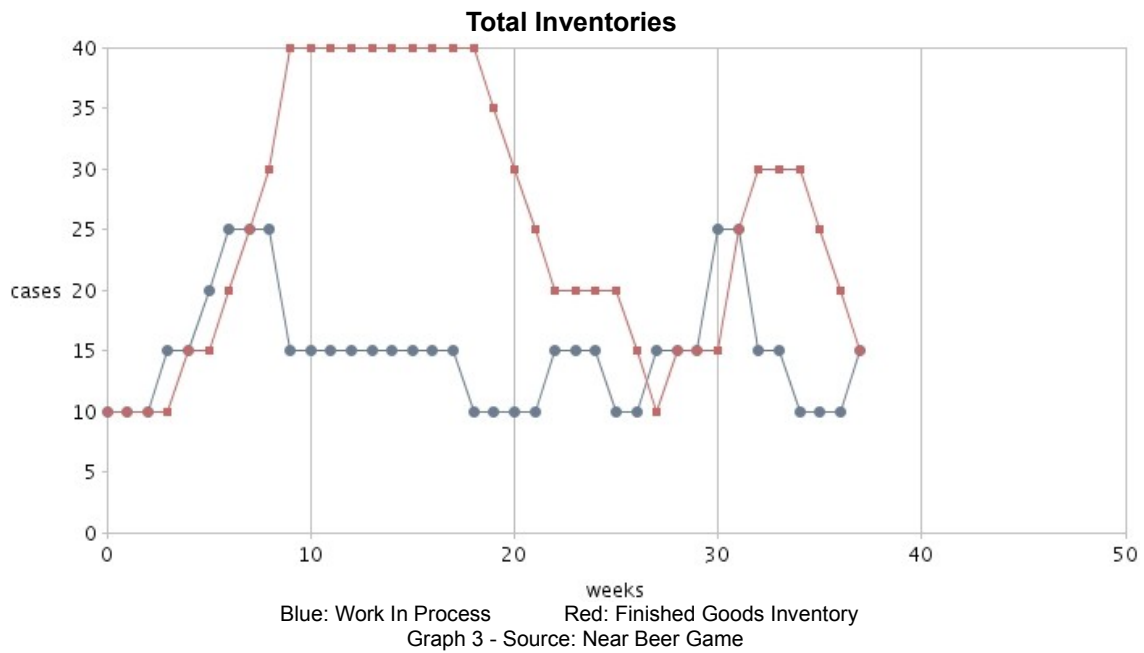
The computer Beer Game is more predictable than the human mind and as a result simplifies the game and makes it easier to understand the basic Supply Chain. Following the completion of the first game it was more feasible to develop a strategy that would overcome the projected challenges, for example a larger inventory early in the game helps to withstand a backlock later on in the game.



Graph 1 - Source: Near Beer Game



Blue: Total Customer Orders Red: Cumulative Unfilled Orders
Graph 2 - Source: Near Beer Game



5. Recap of the Computer Game Part 1

The graphs above were generated from the computer Beer Game and confirm the previous recap regarding the impact on the Supply Chain. The following text provides an analysis of the graphs of the game.

- The new customer orders increase only once at the beginning and has a long lasting effect on the total customer order.
- The total customer order is a combination of the Cumulative Unfilled Orders and the New Customer Order.

- The inventories graph presents the amount of items ordered by the supplier and how the inventory affects the size of order.
- The Shipments Graph illustrates clearly the time difference between the orders and shipments, which indicate the delay that occurs because of the Supply Chain.

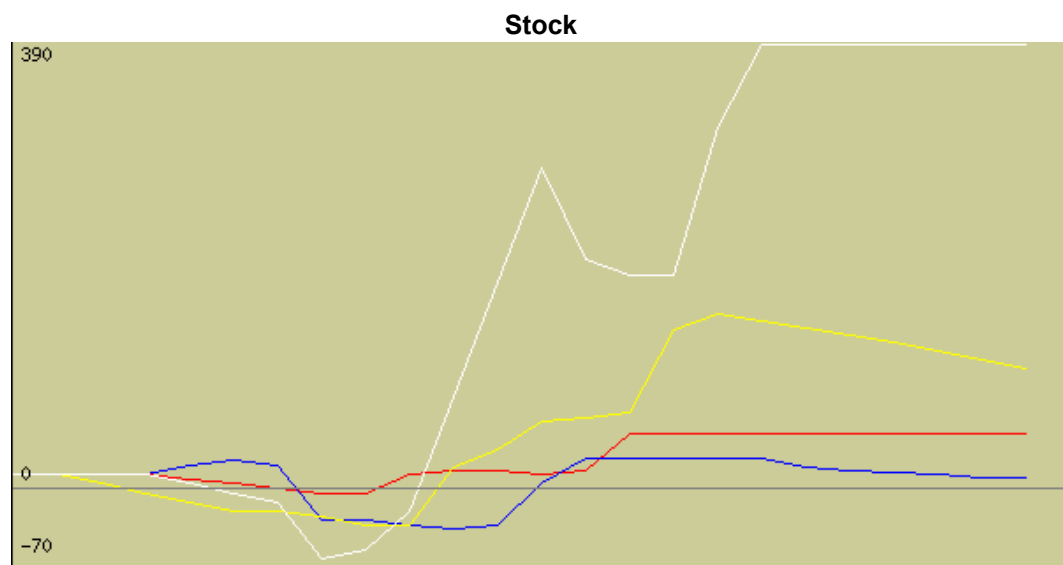
As this game is limited to the customer and supplier a more complex game will be used in Part 2 to illustrate the different game patterns compiled during this research.

6. Computer Game Part 2

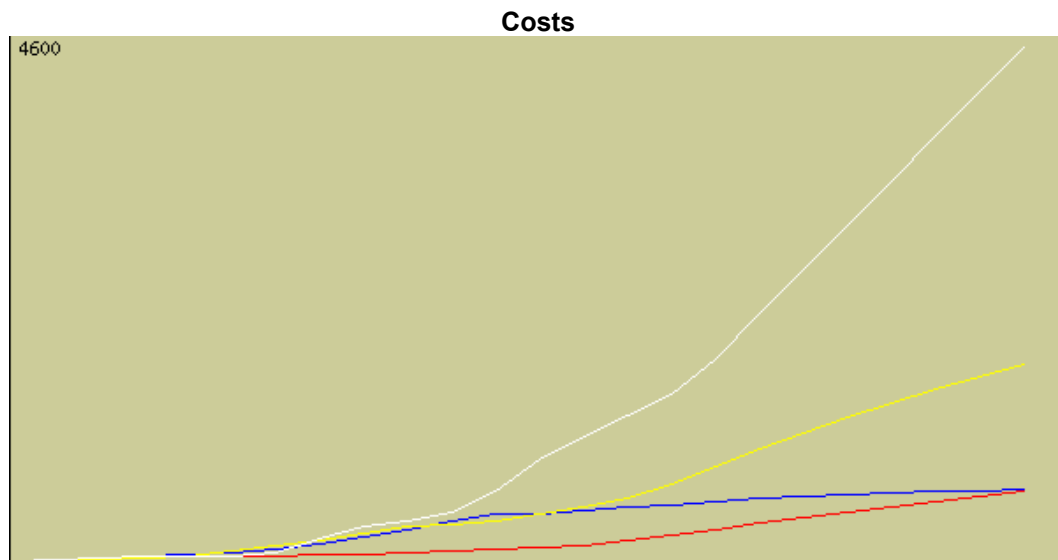
This version of the Beer Game focuses on the four different participants in the Supply Chain (Retailer, Wholesaler, Distributor and Manufacturer) in comparison to the previous version that focuses on the orders, inventories and shipments of products (cited on <http://beergame.masystem.se:8000/>).



Red	-	Retailer
Blue	-	Wholesaler
Yellow	-	Distributor
White	-	Manufacturer



Red	-	Retailer
Blue	-	Wholesaler
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White	-	Manufacturer



Graph 7 - Source: MA Systems Beer Game

Red	-	Retailer
Blue	-	Wholesaler
Yellow	-	Distributor
White	-	Manufacturer

7. Recap of the Computer Game Part 2

Participating in the game as the wholesaler enabled a different perspective on the game because of the influences on the orders from the surrounding participants. As the information was passed from the customer to the retailer and then to the wholesaler the order changed significantly in comparison to Part 1.

Graph 5, 6 and 7 illustrate how the different levels of the Supply Chain react to each other.

- At the early stages of the game a high wholesaler order requires the distributor to increase their order, which occurs with a delay. This high wholesaler order reduces the inventory of the distributor and creates a backlog because of to the insufficient inventory. Furthermore, the cost for the wholesaler are above average but declines over time in comparison to other companies in the Supply Chain.
- As a result of the slow distributor reaction, the wholesaler increases the order significantly to adjust the distributors order and increase the delivery to the wholesaler this is to reduce its increasing backlog. Thereafter, the wholesaler reduces the order volume to decrease its stock until the inventory is minimised. This has a significant impact on the cost for the distributor and manufacturer as the orders create a backlog and a higher inventory at a later stage.

This experiment shows that companies in the Supply Chain have the capability to inflict damage on one another and subsequently suffer due to the Supply Chain dependency. However, this could be solved by the use of modern communication systems.

8. Supply Chain Management

Supply Chain Management is the process of planning, implementing, and controlling the operations of the supply chain as efficiently as possible (cited wikipedia.org).

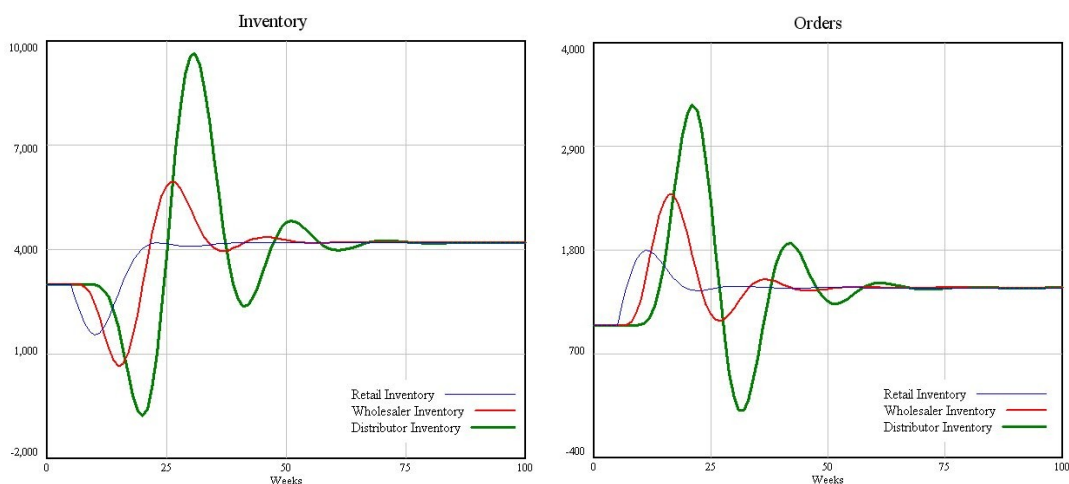
The most valuable element in the Supply Chain System is information. Companies are required to understand the real demand and inventory of their partners in the Supply Chain in order to remain successful in the market. Lack of information and incorrect interpretation of the order can create major issues, which is referred to as the Bullwhip Effect.

Information can enable companies to optimize the entire Supply Chain rather than sub-optimize based on a local interest. This leads to better planned overall production and distribution, which cut costs and give a more attractive final product leading to better sales and better overall results for the companies involved.

9. Bullwhip Effect

The Bullwhip Effect also known as the Whiplash Effect is a common phenomenon in forecast-driven distribution systems such as the Supply Chain.

Customer demand is rarely perfectly stable, which is why businesses have to forecast demand in order arrange their inventory and other resources. These forecasts are based on statistics and ecological as well as political influences because of the possible errors in the forecast companies tend to have an inventory buffer (safety stock).



Graph 8 and 9 – Source: A. T. Kearny Inventory Distribution Simulator

The Bullwhip Effect increases from the customer to the manufacturer, which has an impact on the safety stock of the participating company in the Supply Chain. Furthermore, when the

the demand rises, companies increase their orders. Additionally, falling demand will minimise orders to reduce inventory. This demand is amplified up-stream in the Supply Chain (further from the customer).

Graphs 8 and 9 illustrate how an order influences the inventory of the supplier upstream and therefore creates the Bullwhip Effect, which can increase to huge proportions depending on the orders and size of the Supply Chain.

10. Beer vs iPod

Companies that have mastered Supply Chain Management are able to use the various effects for their advantage.

Companies that produce different variations of one product can control the behaviour of the customer by the quantities of each variation that is being supplied. For example, by producing a limited amount of the cheapest iPod, Apple-Customers are required to purchase the more expensive version.

This example presents that companies have various possibilities to use the Supply Chain not only for improving the product-flow but also for improving the products impact on the market.

11. Conclusion

The Beer Game is a powerful tool used to provide an understanding of how Supply Chain Management can be implemented. It provides awareness of the possible impact that may occur such as the Bullwhip Effect.

Through good communication with the companies in the Supply Chain as well as a thorough knowledge of the companies help to improve the management of the company to develop successful strategies for better customer service and reduce the inventory and dangerous backlogs. Furthermore, through the use of good Supply Chain Management market shares can be gained

12. References

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