

ADMINISTERING THE MIT BEER GAME: LESSONS LEARNED

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ABSTRACT

The popularity of Peter Senge's book *The Fifth Discipline: The Art and Practice of the Learning Organization* has led to a great deal of interest in the Beer Game or Beer Distribution Game which he describes in chapter 3. The Beer Game simulates a distribution channel with four members who must satisfy consumer demand. The Beer Game has been proven to be an effective experiential exercise for teaching participants about marketing and logistics channels in particular and about systems in general. This paper provides guidelines and insights about administering the Beer Game based on the authors experience employing it to teach both undergraduate students and business executives.

INTRODUCTION

The popularity of Peter Senge's book The Fifth Discipline: The Art and Practice of the Learning Organization, has sparked an interest in the Beer Game, also known as the Beer Distribution Game, which is described by Senge in chapter 3 (Senge, 1990). The Beer Game was developed at the Massachusetts Institute of Technology in the 1960's. In the Beer Game teams functioning independently as brewers, distributors, wholesalers and retailers attempt to satisfy consumer demand as determined by the game's administrator. Participants in the game learn several important lessons about operating in systems composed of independent entities with very limited communications between them. The 'Beer Game' has proven to be a very simple yet effective experiential exercise for teaching the dynamics of marketing and logistics channels specifically and systems in general. As such it is of considerable interest to teachers of business. The purpose of this paper is to share what we have learned about administering the 'Beer Game' to undergraduate students and business executives. While there are

several very good descriptions of how to run the Beer Game, there are a number of lessons we have learned on our own since we began using the Beer Game in class and elsewhere. This paper is meant to be supplementary to the other sources of information about the game. We will first describe the game and how it is played. Secondly, we will describe the materials that are available and that we have used and developed to play the game. Thirdly, we will discuss what we have learned about administering the game and some differences we have noticed between how undergraduates and business executives play the game.

Description of Game

The following is a relatively brief description of how the Beer Game is played. It is meant to give the reader a basic understanding of the mechanics of the game. There are several good descriptions of the game available. One is found in Senge's book which describes in detail the lessons taught by the beer game. A set of instructions for playing and administering the Beer Game is available for twenty dollars from the Systems Dynamics Group at MIT. Also, an article by Goodwin and Franklin (1994) describes how the game is played and suggests additional exercises that can be effectively added to it. All three of these are must reading for someone planning to use the Beer Game in the classroom or seminar.

The game simulates a marketing channel with four members: retailer, distributor, wholesaler and brewer. A schematic of the game is presented in Figure 1. The time period for the game is one week intervals. Each week customers buy beer from a retailer's inventory. The quantity of consumer demand is determined by the administrator. Each member of the channel, each week, receives a shipment from

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their supplier and each member places an order with their supplier. The brewery places a production order or plan. Also each week, each member of the channel ships from inventory to their customer.

As can be seen from Figure 1 there are delays built into the system. For example, each week shipments are placed into shipment delay 1 and then the following week they are moved to Shipment Delay 2 where they remain until they are received the next week by the customer. This results in a two week lead time from shipment to delivery. Orders also have a two week lag built into the system. The result of these built-in delays is a four week lead time from when an order is placed until it is received.

Stockouts, orders which cannot be filled, become backorders and must eventually be filled. Each member of the channel is charged \$1.00 for each case of beer stocked out and \$.50 for each case of beer carried in inventory in excess of demand. Because stockout costs are higher than inventory carrying costs there is an incentive to service demand from inventory rather than through backorders. Backorders are cumulative and must be filled eventually when stock is available. There are no lost sales due to stockouts. Participants are told that the “winner” of the game is the one with lowest total costs at the end of the game. The only decision participants must make is how much to order.

The game is initialized in a balanced condition. Consumer demand is a constant four cases of beer per week. Everyone in the channel has 12 cases of beer in inventory. All orders and shipments in the system are for four cases. This condition is maintained for the first four weeks by keeping demand at four cases. In period five consumer demand at the retail level is doubled to eight cases and maintained at this level for the remainder of the game. The result of this increased demand is stockouts first at retail level and then progressing

back up the channel. Stockouts are inevitable because of the four week lead time and because all previous orders are for four cases or sometimes even fewer if a team was trying to reduce their initial inventory of twelve cases to get “lean”. Demand over the four weeks is 32 cases while orders placed are for 16 cases and inventory is 12 cases - adding up to a shortage of four cases. The stockouts and increasing numbers of backorders lead to larger and larger orders as players become frustrated and in many instances panic. Once the large orders begin to arrive and the backorders are shipped, inventories rise rapidly. As inventories soar, players cut their orders to zero which eventually leads to another round of stockouts and large inventories. The single change in demand sets up a series of oscillations in backorders and inventory that is very dramatic. It is not unusual to see single orders for 50 or more cases and inventory levels well over 100 cases per middleman. Goodwin and Franklin report instances of total orders across all players, for a single period, reaching as high as 500 cases in a game where demand only amounts to eight cases per period (Goodwin and Franklin, p.9).

Game Materials

Before play of the Beer Game can begin the administrator must provide some form of game board representing the channel and the various positions of inventories, orders and shipments and something to represent the cases of beer. The systems dynamics group at MIT offers a packet describing how the game works and a diagram of the game board with recommended dimensions and accessories (Sternan, 1984). We found these dimensions and the suggested numbers of accessories to be satisfactory. A professionally produced game is also available from Innovation Associates of Framingham, Massachusetts which is rather expensive although if it is for classroom use only a

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substantial discount is available.

Our first version of the game board was to draw the appropriate rectangles, arrows and labels onto poster boards using markers and based on the measurements suggested by Sterman (Sterman, 1984 p. 8). Each member of the channel was represented on a single white poster board with black lettering and lines. The label of each rectangle was written inside the rectangle. For play, the poster boards were placed in line on long tables. This version of the board had the advantage of spreading the teams out, which facilitated reduced communication between them but because the boards did not touch one another it may not have been very clear to the players, at least at first, that they were part of a channel. We used one size of common metal washers purchased in five pound boxes from a home center to represent cases of beer and 12 ounce plastic cups, all red with white interiors, to hold the washers. Fourteen cups per channel are required. The plastic cups were placed in the appropriate rectangles. The guidelines for the number of washers provided by the MIT directions (Sterman, 1984) worked very well. We decided to use washers instead of pennies. although pennies would have been cheaper, because we were concerned that pennies could find their way from players' pockets into the game to avoid stockouts. We used 3"x 5" index cards for the deck of consumer demands with the quantity of demand written on them in pencil so that the number would not show through the back and tip the retailer team off to the next period's demand. We used the inexpensive, small, plain, unlined notepads, bought in quantity from an office supply store, for the order forms. These have the disadvantage of being thin enough to see from the back what is written on the front thus tipping players off early. The total cost of this version of the game was about \$40 and took three to four hours to prepare. It provided sufficient materials for 30 students playing in two person teams.

We used this version of the game board and accessories several times with undergraduate Logistics students with reasonably good results. One modification we made was to buy a box of larger metal washers to represent ten cases of beer. These make it easier, and more importantly faster, for players to count cases during those periods of the game when the orders and shipments become very large. The primary advantage of this version is that it is inexpensive, can be produced in a relatively short time and is somewhat adaptable to various types of classroom furniture. The major disadvantage is that it does not look very professional. This was not much of a problem with undergraduate students but when we had an opportunity to play the game with a group of business people who would be paying us, we thought we should upgrade our equipment.

The first priority was to improve the appearance of the game board. Hand printed poster boards would not do for a professional presentation. We ended up at Kinko's where the suggested hand printed board from MIT was scanned into a computer, typeset and enlarged so that it could be copied onto eight foot long sheets of paper. It cost \$60 for the design and the eight foot long copies are several dollars each. We decided to go with black printing on white paper rather than four different colors, one for each channel member. because the cost for four color copies soars to several hundred dollars. We opted to add color with markers by just drawing one colored line inside each rectangle so it was clear which part of the game board belonged to which team. With the poster board, the separation of teams was clearer but the flow of the game was not. We found the eight foot game board suggested by the MIT group to be too short. The channel members were too close to each other creating excessive communication and discomfort from crowding. We plan to go back to the poster boards or put each half of the board on eight

foot sections. On the board itself we moved the labels of the boxes to immediately below them so that the labels could be read without moving the cups.

We continued to use plastic cups but we got cups to match the colors on the board so that each channel member had their own color of cup. We also continued to use metal washers. Poker chips would look better but they are considerably more expensive. All other materials remained the same. The total cost for this version of the game was less than \$200.

Administering the Game

There are a number of factors to keep in mind in planning and administering the Beer Game. The first is time. It is critical to have enough time to play at least around 35 periods of the game so that each team experiences the oscillations of inventory, order quantity and stockout levels. If they do not experience the oscillations, there is really no point to the game. Therefore, there must be at least two hours allotted to play and the administrator must manage the time well so that everyone “finishes” together and has recorded their team’s inventories, orders and stockouts for the debriefing session.

We have found the first four periods of the game to be critical in establishing a smooth running game session. Although the game is rather simple, it takes a little time for most people to get comfortable with it. The first four periods are when the demand is stable and the game is in balance. There are no disruptions or difficult decisions to make at this time. It is critical at this time that each team get some personal attention. Having a “coach” who knows the game available for each channel (four teams) is optimal but one coach covering two channels is workable. The more coaches the faster the startup.

The brewery is the most difficult position and should be carefully watched to make sure all of the steps are being executed properly. There is a tendency for the team at the brewery to skip steps and reduce the lag time. This is particularly a problem when shortages begin to develop. The brewery team may bow to pressure from irate customers for more beer by manufacturing to order rather than placing the production order and waiting the two weeks to produce the ordered quantity. If this happens, the oscillations in inventory and stockouts will be small or virtually nonexistent thereby nullifying the effects of the game. As the administrator, the discovery that this has been occurring does not produce a pleasant feeling. We have found it possible to recover from this situation by immediately correcting the team’s play. The problem is that it will take a number of periods for the effects of the game to begin to show and it lengthens the time of play for all the channels because you cannot begin the debrief until everyone has finished play. Diligence and personal attention by the coaching staff is the best way to prevent this problem. The distributors and wholesalers may also collapse steps and must also be monitored. Retailers rarely have problems. Feelings and emotions can run fairly high when the shortages occur. We have had teams become very adamant that their supplier get product to them and have had breweries simply dip into the “reserves” to shut them up.

Another time and learning issue concerns the size of the teams. Two members per team seems to be optimal. One team member makes the moves such as receiving shipments and shipping by putting washers into cups while the other member keeps the records. Three member teams take longer to make the ordering decision and when using the eight foot game board it is crowded causing unwanted contact and conversation between teams. With two members they tend to help each other get involved more in the game. A third member

often seems to be left out. The number of channels is dependent on the number of coaches available.

To facilitate startup of the game we give an overview of it using a slide/overhead of the game board and step by step directions. We also hand out written instructions tailored to each position. These step by step instructions would be effective if all players read and followed them. Unfortunately, this is not usually the case. Coaching and walking each team through their moves the first few periods is essential. Making sure the game is understood early prevents major headaches later on. It is very important that each team establish a rhythm of play and that every team is playing in the same time period and not jumping ahead. It is a good idea to post the current period of play and to call it out to keep everyone in step.

In comparing undergraduate students to business executives we were surprised to find that the executives seemed to catch on to how the game is Played much more slowly than the undergraduates. We were particularly surprised because the executives were employed in logistics functions such as transportation, inventory management and customer service. These are people who are familiar with shipping, receiving, placing orders, receiving orders and scheduling production.

The debriefing session goes well as long as everyone experienced the oscillations in inventory and stockouts. The debriefing notes and suggestions provided by Sterman (Sterman, 1984, pp. 4-12), Goodwin and Franklin (Goodwin and Franklin, 1994, pp. 11-15) and Senge (Senge, 1990, pp. 40-54) are very helpful. We have found the debriefing session to be very lively and to flow quite easily.

What Participants Learn

While both undergraduate students and executives feel that the game does an excellent job of bringing to life the concept of "supply chain management," students were especially likely to comment that the game helped them to grasp the nature of relationships between different channel members. Students also indicated they were surprised by how easily it was for the system to get out of balance, and were struck by the complexity created by just on simple product. Almost all participants assumed the "problem" was changes in external orders, and very few, if any, participants focused on the internal "system dynamics" nature of the problem. However, after revealing the flat order rate, almost all participants came to the realization that the internal structure is the key problem that reduces efficiency and effectiveness. The game does an excellent job helping participants to reach this realization.

The game also does a great job of helping students to realize the benefits of common supply chain management proscriptions for improving performance. For instance, while the concept of benefits from "time postponement" is somewhat understood by most students, many students indicate that the game helps them to understand the benefits in a practical and managerial sense. In game terms, this means that they would like to eliminate or reduce the ordering and shipment delays that are built into the system. It also means that, often for the first time, they can see the dramatic benefits that can come from real life implementation of shorter and more reliable cycle times. Likewise, the game helps students to see the difficulty in "forecasting" demand and supplying customers out of inventory. The game helps them to better understand the concept of "form postponement" and the benefits of a "pull" system rather than

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producing to stock.

The game also helps students to fully understand the benefits of increased communications within the supply chain. They are amazed by the problems in communications for just one simple product, and by the number of transposition errors and mistakes that they end up making in processing simple orders for just one product. They are quick to point out that they could have alleviated a lot of the problems if they could have simply "talked to" the people two or three levels down or up the channel from them. Students state that while they "kind of" understood the benefit of better communications from classroom lectures, the game made the benefits of such communication "obvious for anyone." Students also report that the game helps to bring to life the concepts of "direct to store delivery(DSD)" and "channel separation." Several groups of students have wanted to "fix" the system by eliminating several channel members and shipping direct from brewery to retailer but when it was pointed out that these channel members may be needed for "sales" purposes, students volunteered that in that case, the channel member should be used for sales but "bypassed for actual physical movements." This helps them to grasp both of the above concepts.

Business executives report many of the same learning benefits from the game. However, they are more likely than students to realize the difficulty in implementing some of the proposed solutions to supply chain problems. For instance, they quickly point out that in the real world the problems are even more difficult than in the game. For instance one person reported that they distribute beer, and that they have not one SKU but 500. These executives note that the ideal system would be not just to eliminate shipping delays, but to get to a flexible manufacturing situation where they could produce all SKUs to order and not have to forecast

and build inventory to fill orders. These "form postponement" solutions seem more apparent to executives than students but at the same time they are more likely to realize the limitations in being able to implement these solutions. Executives are also more likely to question how realistic it is to "improve communications" between channel members, and will often point out that DSD and channel separation concepts can result in "very high" transportation costs compared to shipping in bulk to intermediaries.

Conclusion

We have found the Beer Game to be a very effective experiential exercise for both undergraduate students and business executives and that a competent administrator can make it even more effective. A set of game boards and accessories can be developed for under \$40 and a fairly professional set can be developed for under \$200. Anyone who is interested in running the Beer Game can do so if they take the proper precautions and tend to the details.

REFERENCES

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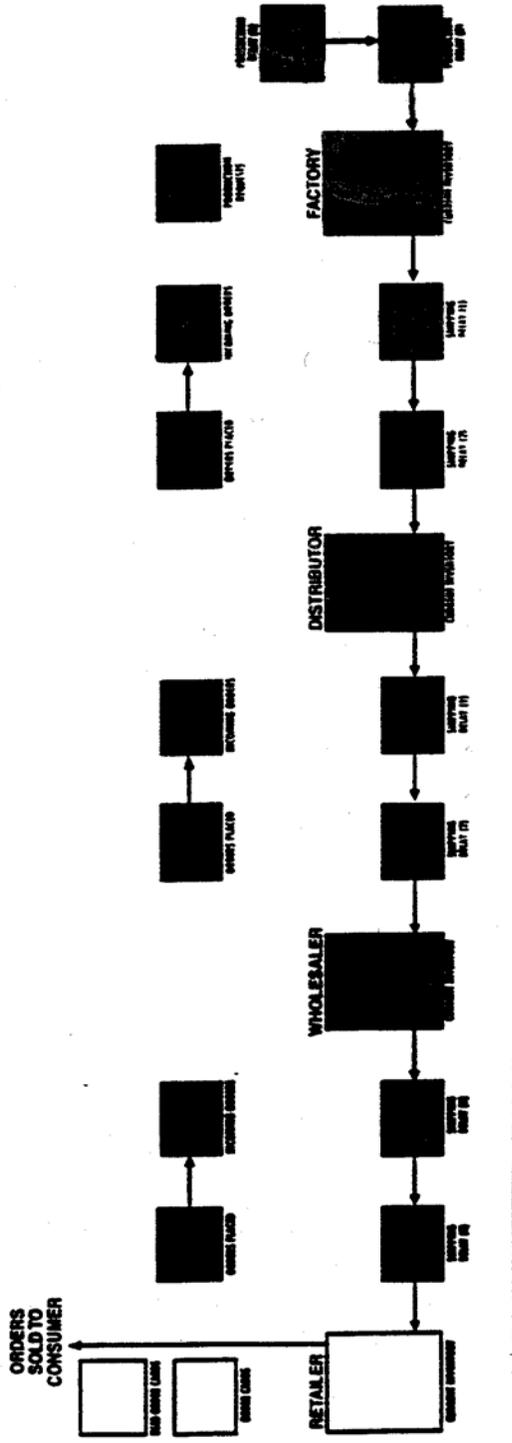


Figure 1: Schematic of Beer Game Game Board