SOME MODIFICATIONS INTRODUCED TO IMPROVE THE BEER GAME

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ABSTRACT

The Beer Game is still, today, one of the tools with the greatest impact in demonstrating that the behaviour of a system is generated by its structure. However, we believe that in its original form too much time is needed to play it and carry out a proper debriefing. In addition, it is not always easy to guarantee the hypothesis of isolation for the different positions within the game. Finally, we feel that participants often have difficulty in picking up quickly and clearly the process characterizing the game. To deal with these and other problems we have introduced certain modifications which, in our view, totally or partially resolve these difficulties.

1. Introduction

As is well known, the beer game offers, with great clarity and impact, a means to demonstrate that the structure of a system generates its behaviour and to make management realize the need to use Systems Thinking when dealing with complex organizations. On account of this, we have been using it as a "shock weapon" to introduce courses in Systems Thinking and/or System Dynamics. In order to improve the working of it in this context, we have gradually incorporated a series of modifications (Machuca, J.A.D. et al., 1991), with a view to:

* safeguarding the observation of the rules of the game
* speeding up its progress
* reducing possible calculation errors
* reducing running time
* facilitating the debriefing

2. Some "physical" changes in the Beer Game.

In order to reproduce the classic isolation that characterizes the analytical approach, one of the rules of the beer game is the prohibition of communication between the different players. Therefore, no information should be available on the state of the inventory of adjoining positions. Nor should the value of the orders placed by the player immediately to the left be known until after the two delay periods which are a feature of the transmission of information within the system.

However, the above-mentioned rule is not easily observed. The cases of beer moving along the distribution chain are represented one-to-one by coins or chips which are placed on the flat surfaces symbolizing warehouses and shipping delays; these can be seen easily, given the physical proximity between players. In addition, the 1/1 correspondence between cases and coins presents a further drawback. When large quantities are being dealt with, which is not infrequent, a real physical problem of snowing under" arises and, in addition, when real stocks must be noted the count is slow.

In order to prevent these problems we decided on a number of changes. Firstly, we introduced chips of various colours and sizes representing different quantities (1/5/10) so as to reduce the number of chips in the chain. In addition, in order to facilitate the exchange of chips, we placed

plastic tumblers in front of each player, containing sufficient quantities of chips of different values. Secondly, at the pints representing shipping delays we placed opaque plastic tumblers to represent haulage trucks; this eases the flow of movement of material and makes it impossible to see the goods being transported. We also placed plastic tumblers on the warehouses (one for each type of chip); in this way the beer in store remained concealed from curious eyes.

As regards orders placed and incoming orders, these are noted down on slips of paper through which the amounts written down could quite often be seen. To prevent this, on the blocks representing these orders we placed plastic tumblers into which the folded slips are put.

These modifications safeguard the isolation of each position and at the same time speed up the flow of material and information throughout the production-distribution chain.

As regards the gameboard itself, we carried out some changes here as well (see figure 1). We decided to standardize the different positions; thus, we replaced "production requests" by "orders placed" to bring it in line with the other positions. To complete this standardization we introduced a block of incoming orders, to complement the previous block. These orders are filled, whenever possible, by the assistants of the game's facilitator; in this way the player in the "brewery store" position need not know that there is no limit to the incoming supply, or concern himself with filling the orders which he himself places.

With the above changes we were able to avoid the frequent doubts and breaks arising in the early phases of the game, particularly from the players occupying the factory position.

Finally, we broke the board down into 12 rectangular parts (four of them 28 cm. x 20 cm. and eight 28 cm. x 40 cm.) which can be fitted together. The arrows indicating the direction of flows in the system can have two different lengths (the greater of them involving three additional rectangular blocks), thus enabling the distance between players to be increased or reduced as required and also making the game adaptable to different table sizes.

3. Modifications in the prompts indicating the different steps of the game to the players

In the course of numerous repetitions of the game we observed that, particularly in the initial phases (the first 8 to 12 weeks), some misunderstandings and doubts arose as a result of some players having difficulty in grasping the mechanics of the game. This leads to the game being interrupted and holds back its progress.

Working from the difficulties observed and discussions with the players, we decided to introduce some slight modifications in the prompts directing the various stages of the game and also clarify some of them or insist on certain aspects which were at times being ignored by the players, leading to interruptions and/or errors. All this is projected on a screen throughout the game (see figure 2).

4. Some modificatons in the Record Sheets

The original Record Sheets only include the concepts of "current stock", "backlog' and "orders placed". However, we found that players constantly need and generate complementary information records such as "incoming orders" or "orders information to be filled". Accordingly, and following the order laid down by the steps of the game (see section 3), we altered the record sheet, including useful new concepts such as formulas for the calculation of orders to be filled and backlog (see figure 3), which at times are forgotten by the players (1).

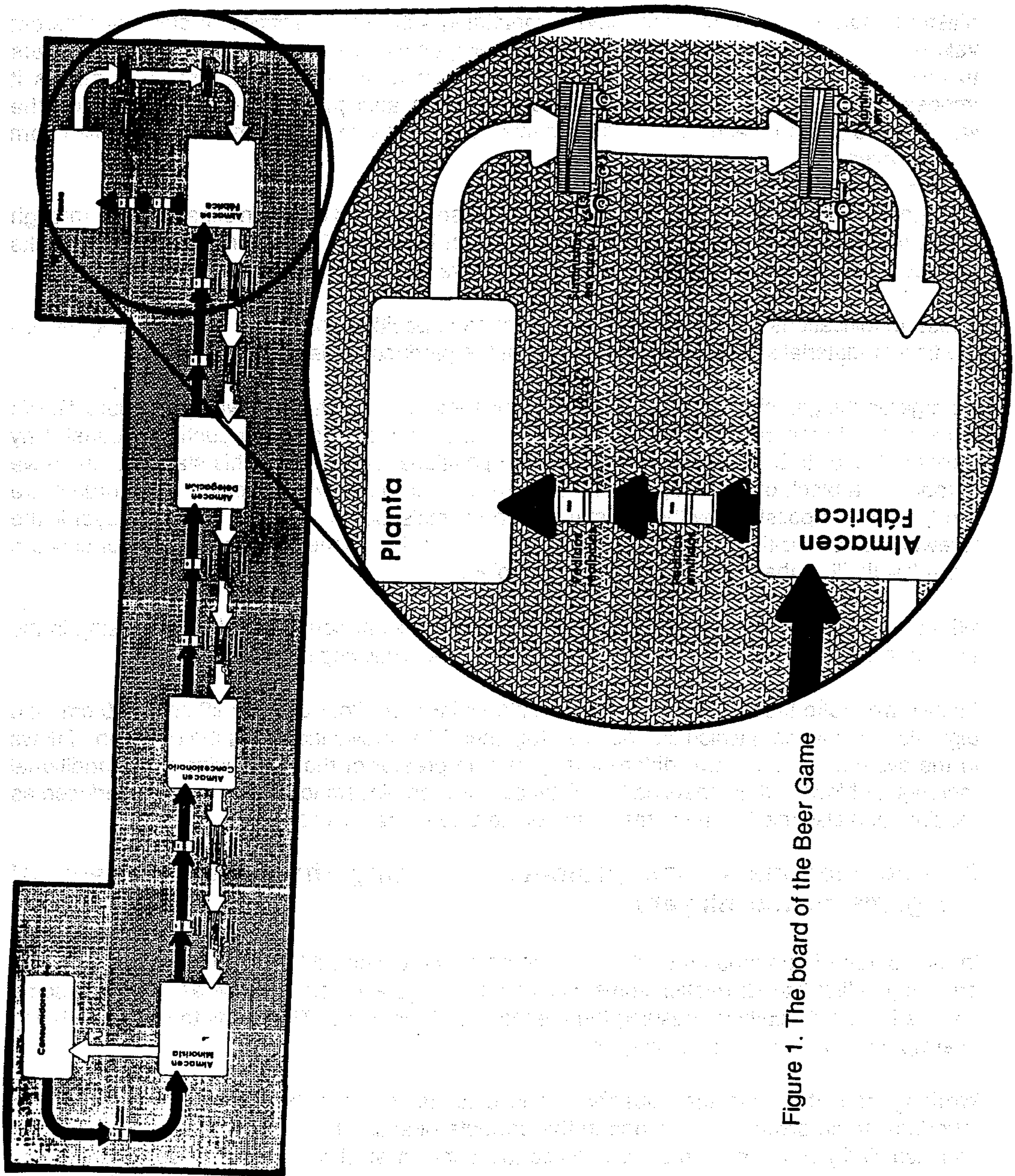
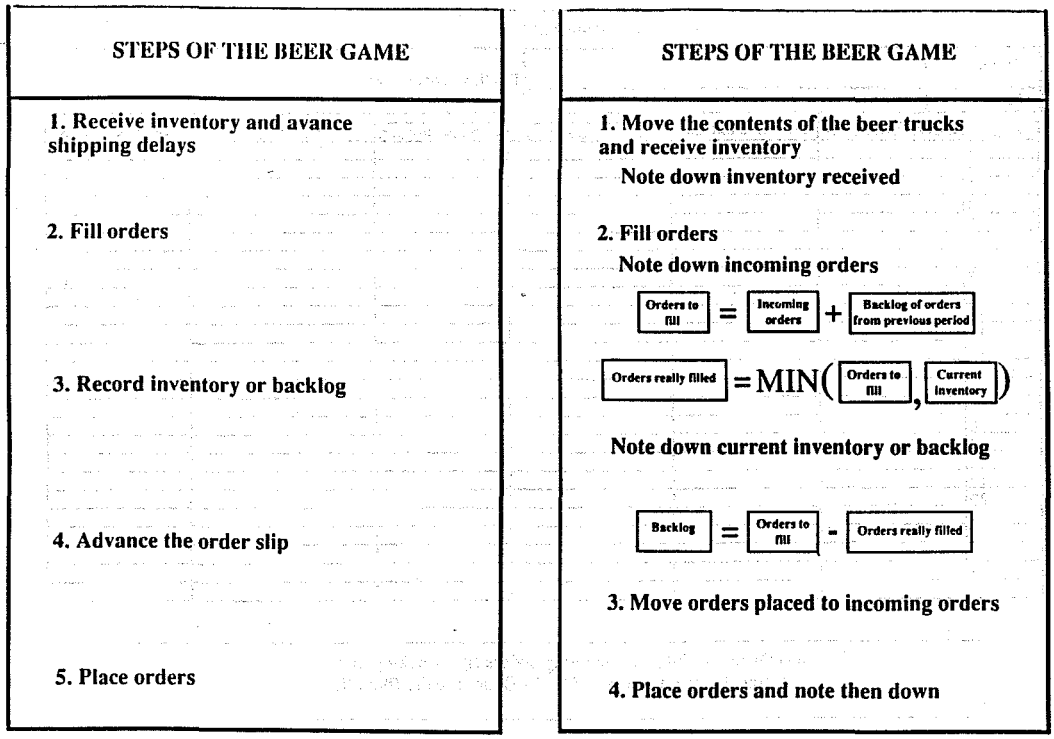


Figure 1. The board of the Beer Game



2a. Original text

2b. Modified text

figure 2. Steps in the Beer Game

We also created two sheets to draw other useful complementary graphics. On the first are drawn the incoming inventory and incoming for each position; on the second, once the game is over, the participants -except the retailer, who is the only one who knows it- draw the demand from clients as they imagine it to be. This graphic was already envisaged in the original version of the game for comparison, in the debriefing, with the real demand. Finally, we added a series of "comment sheets" on which the participants are to note down impressions, changes in decision-making , causes, etc., as the game progresses, indicating the period in which they occur. This is very useful for the debriefing and the later in-depth study of the players' behaviour in the course of the game.

5. Implementation of the game on a spreadsheet.

The mechanics of the game require a series of calculations to be carried out to keep up to date the values of the different variables that come into play (inventory, backlog of orders, orders to fill, etc.). The speed which is part of the dynamics of the game, together with a faulty perception on the part of some players of some of the concepts used (e.g. backlog of orders, difference between orders to be filled and orders filled, etc.) give rise to calculation errors and delays in the progress of the game, due to breaks requested to clarify doubts or to correct errors that have been discovered. In addition, once the game is over, the calculation of costs and the creation of graphics for the results is also tedious and time-consuming and breaks the rhythm generated by the game itself.

Record Sheet nº 1

GIDEAO

Name:		Position in the Company:	
Team:			

Week	RECVED. INVENTORY	INCOMING ORDERS	ORDERS TO FILL (1)	CURRENT INVENT.	BACKLOG(2)	ORDERS PLACED
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

-(1) Orders to fill (i) = Incoming orders (i) + Backlog (i-1)
(2) Backlog (i)= Orders to fill (i) - Orders really filled (i)

Figure 3 Record Sheet

In view of the above, using the Excel spreadsheet we created a representative model of the game, which automatically works out for each team all the necessary calculations for the different positions. Each player simply has to feed in the orders placed during each period. (Figure 4)

Period	RECEIVED. INVENTORY	IN.ORDERS	ORDERS. TO FILL	BACKLOG	CURRENT INVENTORY	ORDERS PLACED
1	4	4	4	0	12	4
2	4	4	4	0	12	4
3	4	4	4	0	12	4

Figure 4: Spreadsheet. Calculations for retailer.

In another module of the spreadsheet the various costs generated in each position for every period are calculated, as well as the total cost for each team.

The evolution of the effective stock of the different positions in each team (real stock on the positive side of the ordinates and backlog on the negative) is also obtained in graphic form, both separately and superimposed in one graphic. The latter makes it possible to clearly observe the phenomena of oscilation, phase lag and amplification characteristic of the game. The same procedure is followed as regards the "orders placed" variable. The final series of graphics covers partial and total costs. (Fig. 5)

To make for easier comparison of the evolution of the above-mentioned variables for the different positions, it is sometimes advisable to smooth off the variables in order to reflect the

trends more clearly. An adjustment was therefore incorporated, yielding reasonably satisfactory results. (Figure 6)

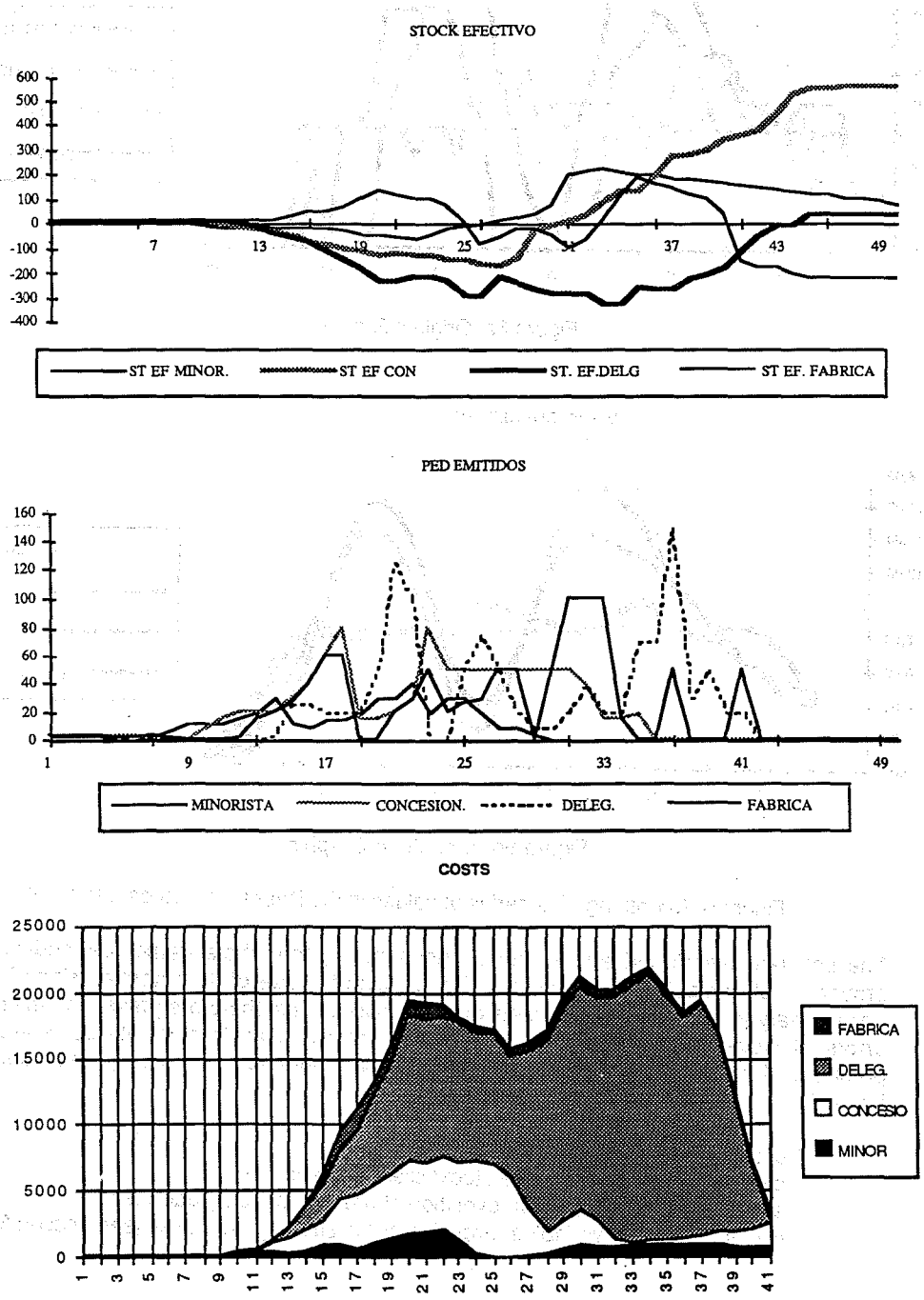


Figure 5. Graphics for the Beer Game (effective stock, orders placed, costs)

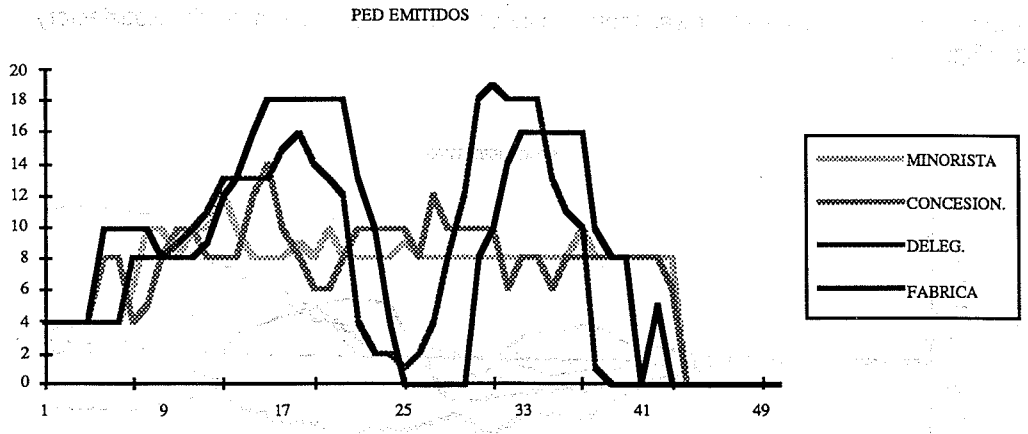


Figure 6a. Original Graphic

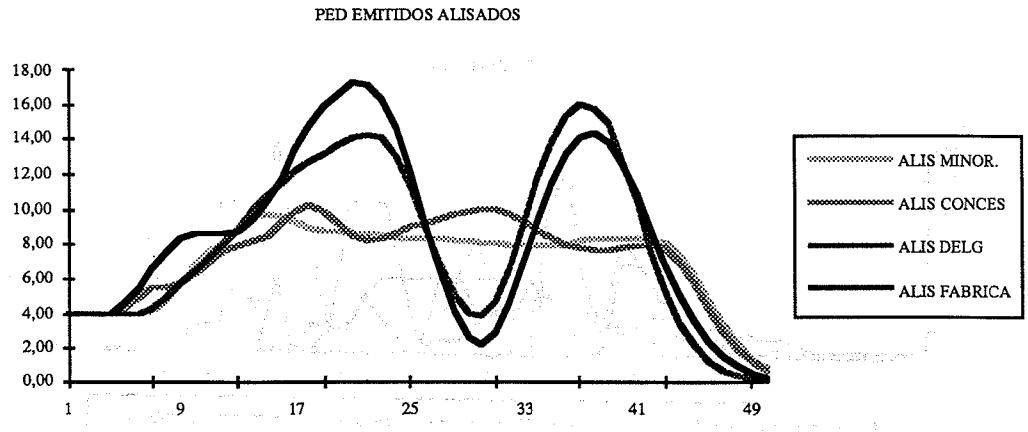


Figure 6b. Smoothed Graphic

Figure 6.Smoothing off a series of values in the Beer Game (orders placed)

The software mentioned above can be used during the whole game (depending on the proportion of computers to positions), thus making full use of its potential, since it is then unnecessary to fill in the record sheets or make calculations, therefore preventing the resulting errors. However, we generally use it when the game is over, to calculate costs and create graphics, which are projected onto a screen so that a number of interesting comparisons can be made, such as:

* costs of the different teams
* evolution of teams' effective stock/ client demand
* evolution of effective stock/ evolution of orders placed by each team
* evolution of team variables/ evolution of "no strategy" variables (see section 6).

6. Incorporation of "no strategy" strategy into the debriefing

When the game is over and the various costs and graphics are obtained for each team, the facilitator conducts the debriefing so that the participants can see that, contrary to what they might think:

a) there is no one "culprit" in each team.
b) neither are external events the reason for the behaviour obtained.

Having reached this point, as P. Senge (1990, chapter 3) points out, the players have only one recourse to fall back on: to blame the system and say it is probably unmanageable. To demonstrate that this is not true and that a better job can be done, the author puts forward the example of "no strategy" strategy, that is, each player places orders exactly equalling those coming in, without concerning himself with anything else. In following these guidelines a certain stability is reached around week 11, and although it is, of course, not a good strategy, it serves to show that the huge oscilations, characteristic of the game (Figure 7) can be eliminated, better costs results being obtained in 75% of cases than were obtained by the different teams (see Figure 8).

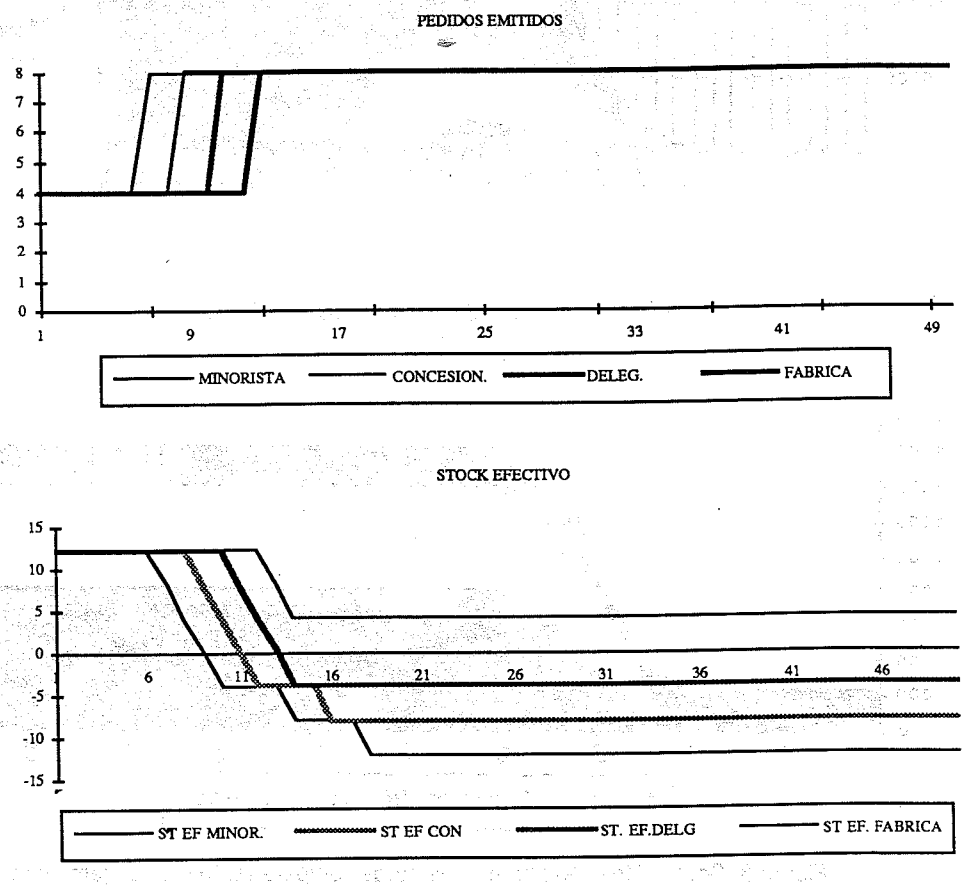


Figure 7. Results of the "no strategy" strategy (orders placed, effective stock).

When faced with these data, participants see the last possible excuse for generally deplorable results disappear into thin air, for they now see that:

c) the system is not unmanageable,

which brings down the last barrier between them and the final conclusion: **It is the structure of the system that generates its behaviour.**

In view of the above, we believe that it was advisable to somehow introduce the "no strategy" strategy into the game. Depending on the case, we do this in two different ways:

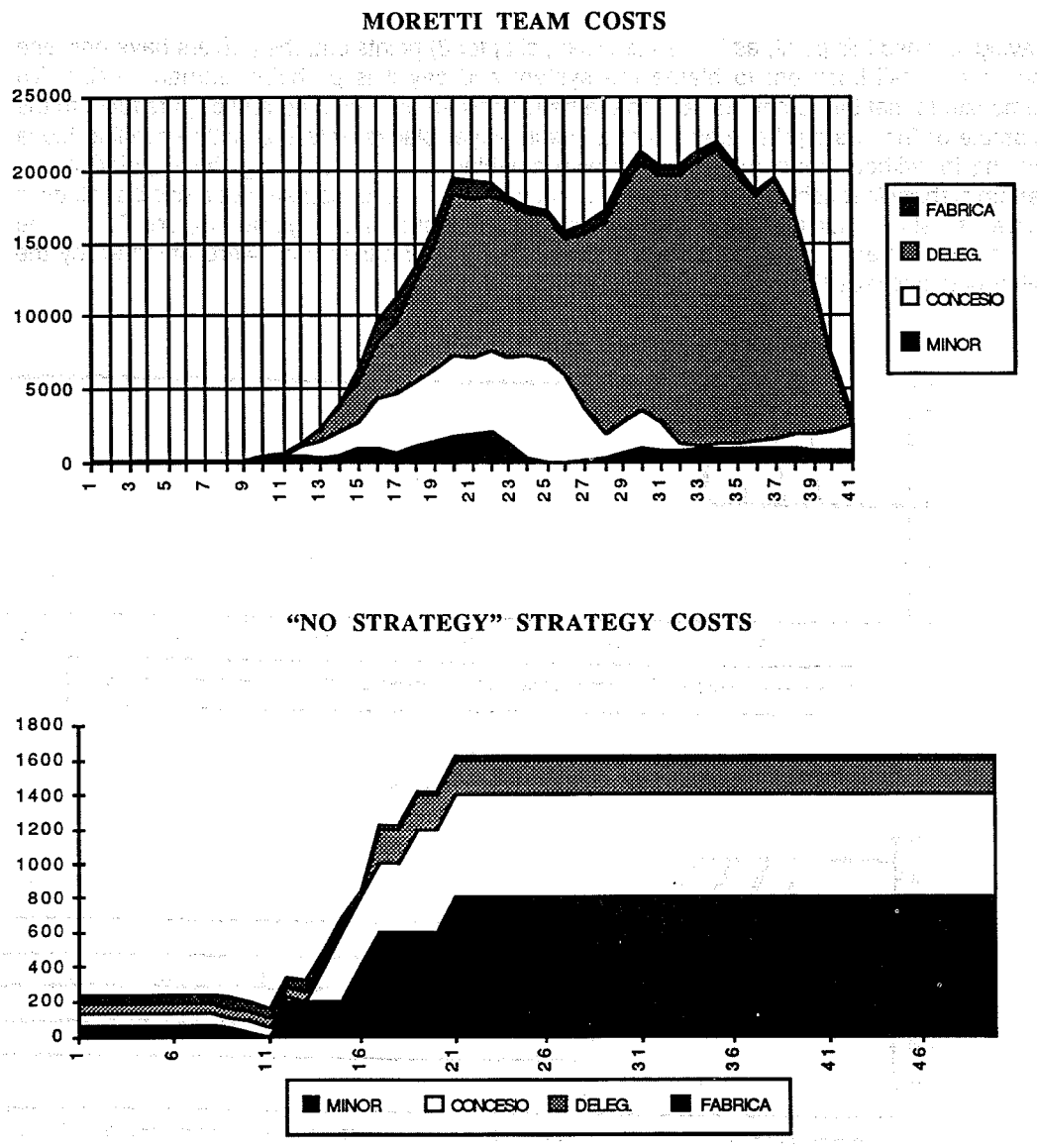


Figure 8. Costs of the "no strategy" strategy compared with typical game costs

* during the game (when there is a big enough number of participants), making a team play this strategy.

* after the game, once this point has been reached in the debriefing, through the spreadsheet-based program mentioned in the previous section.

We reckon that the results which derive from it make it worthwhile to incorporate this strategy into the game and use it in the debriefing.

7. Documentation produced for the Beer Game.

In order to make the task of potential Beer Game facilitators easier, and following the lines and objectives mentioned in another paper presented by us at this Conference (Machuca, J.A.D. et al., 1993), we created comprehensive documentation (2) (Machuca, J.A.D. et al., 1991) consisting of:

a) Player's Manual
b) Teacher's Manual
c) Set of 31 transparencies complementing the Teacher's Manual.

In addition to the above, we have produced the following software:

d) Presentation for Macintosh to replace the transparencies (1992).
e) Spreadsheet for calculation of the results of the beer game and creation of the relevant graphics (see section 4) (1991).

Notes

(1) These formulas are also permanently projected into a screen from the transparency showing the steps of the game (see section 3).
(2) The Player's Manual and the Teacher's Manual are based on our own experience (see the present paper) and the following works:

* Senge, P.: "Outline for postgame discussion". M.I.T. D-3236
* Senge, P.: "The fifth discipline". Ed. Doubleday Currency, 1990.
* Sterman, J.:"Instructions for Running the Beer distribution Game", M.I.T. D-3679, 1984.
* Sterman, J.:"Modelling managerial behavior. Misperceptions of feedback in a Dynamic Decision making experiment", Management Science, Vol. 35, nº 3, 1989

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* Machuca José.A.D.: "Documentación para el Juego de la Cerveza", DEFDO, 1991
* Machuca José A.D, Machuca Miguel A.D., Ruíz José C., Ruiz Antonio:"Systems Thinking Learning for Management Education. What are we doing in Sevilla?", in Machuca J.A.D. and Zepeda E. (Eds), System Dynamics'93: The role of Strategic Modelling in International Competitiviness, The System Dynamics Society, 1993
* Senge P.: "The fifth discilpine", Doubleday Currency, 1990