# WHEN CREATING AND USING GAMES, ARE WE NEGLECTING THE ESSENTIAL OF SYSTEM DYNAMICS?.

José A. D. Machuca
G.I.D.E.A.O.
Dpto Economía Financiera y Dirección de Operaciones
Universidad de Sevilla Avda. Ramón y Cajal, 1
41018 Sevilla. Spain

## ABSTRACT

*As it is well known, the explicit representation of systems structure (e.g.: causal diagrams) is one of the main features of System Dynamics. In my view, this precious tool is perhaps being neglected or, more precisely, not utilised to the full when building and using models and games. In this way, the structure of the systems is hidden and the transparency of the models is lost. This can be especially negative in games which not allow the players to access the structure. That can leads to a decision making not based on the causes but on the symptoms, as standard black box games do.*

One year ago I had a conversation with a colleague who lamented on the inadequacy of the conventional analytical approach that most economists use when dealing with economic problems. I told him about the System Dynamics approach and its great potential for understanding the behaviour of economic variables and finding out the underlying causes. Although he realised in the course of our conversation that he agreed with the principles of the Systems Approach, he felt very skeptical about the power of system Dynamics when facing problems in social systems. In spite of these reservations we decided to prepare a case for his students which broke with the traditional way of teaching in his field, Economic Policy.

We agreed to use the conceptualization stage as a first trial, which

would lead to the causal diagram of the chosen problem. This consisted in showing the Monetary Policy and its tools as intermediate instruments for reaching the final goals of Economic Policy as well as pointing out the complex interactions between the different variables (1). We wanted to verify two main interrelated points:

1. Whether our approach was in fact more realistic than the traditional one.

2. Whether the students would obtain a better understanding of a problem which was not easily understood.

After using the case developed with a number of groups we have reached some interesting conclusions:

1. My colleague, who has been working for almost twenty years in this field, recognised that the process of conceptualization clarified the ideas about the way in which the Economic System works. The different interactions became clearer and the causal diagram gave a very realistic picture of the case under study. The discussion was facilitated by the transparency of this diagram and the results were improved.

2. The building of the causal diagram in the classrooms provoked more motivation and more interesting discussions than in previous years, allowing the students to capture a number of facts easily neglected and badly understood when traditional methods were used.

3. The different groups of students attained an easier and better understanding of the way in which the Economic System works, obtaining a clearer systemic view of the case under study. The results obtained when asking questions or doing exams were considerably better than in previous years.

These results will perhaps seem evident to system dynamicists but this is not the case for people working in different fields and who are not familiar with System Dynamics. For us it is absolutely logical, for them it is a new discovery. For years we have been preaching that, when dealing with complex systems, it is essential **to look for the causes of the behaviour** of the main variables of the systems under study **rather than pay attention to the symptoms.** For this reason the most critical

aspect of building a model of a social system is to find out its structure, represented for example by a causal diagram. However, I think that this precious tool is perhaps being neglected or, more precisely, not utilized to the full when building models and games. I fear that this is not just a feeling but a reality. The great development in software makes the process of building a model much easier. A superficial view of this fact could suggest that building a System Dynamics model is within the reach of anyone but in reality such a thought is illusory:

**Any model based on a faulty understanding of the structure will be a faulty model, and time spent on the conceptualisation stage is the best investment in building a model.**

Perhaps because of space or time restrictions, very often authors present just the results obtained in their work (models or games), but most times they do not tell us about the structure underlying the behaviour obtained. This could be dangerous, bearing in mind the previous paragraph.

Over the last few years a kind of "fever for games" has arisen among System Dynamicists and I am no exception. This is another subject to take into account when considering the comments made above. I believe that System Dynamics can be really valuable in the games field because our approach is extremely effective, especially when compared with traditional approaches. Nevertheless, at least two questions must be asked when a game is under consideration:

1. *Is the underlying model correct?*

This question can be crucial, especially if the "fever for games" spreads quickly and the tools for building games become numerous and easily accessible. I mentioned above that because of the development in software anyone can build a model (but will it be a correct one?); we will soon be able to say that anyone will be capable of building a game, but once again we can add: will it be a correct one?. In the case of games, the above-mentioned problem is particularly critical because they are supposed to help the player in:

* Reaching a better understanding of reality when faced to decision-making.

* Improving his process of decision-making.

* Acquiring knowledge about the system much more rapidly, etc.

But what will the player achieve if the underlying model is erroneous?.

This question brings to mind a financial game based on a spreadsheet which I was asked to evaluate a few years ago. At first sight the game appeared to be really good: motivating, quick, an attractive presentation, well chosen goals, etc. Nevertheless, when I had access to the model I was able to observe several conceptual errors leading to incorrect results which could provoke erroneous decisions. This would be particularly serious when using the game to help in real decision-making. Fortunately the game was modified before it came onto the market. But, is it always possible to do this in time in all cases? It is difficult to know, but I am afraid that the answer to this question. might well be: no!

The facts commented on above become more critical when we realise that most of the games which have been developed based on System Dynamics do not allow the user to access the structure of the underlying model. I think that acting in this way we are losing one of the best features of System Dynamics: Transparency. I believe that there should at least be a possibility of having access to the causal diagram related to the game, and not only because of the facts referred to but because of the following question.

2. *Even when a game is based on a good System Dynamics model, if the player cannot access the model structure (e.g.: the causal diagram)* ***what value are we adding to traditional "black box" games?***

The only added value is the underlying model made by a Systems approach, and one which is therefore more realistic. Of course this is very important but, on the other hand, if we compare it with traditional games, several questions arise:

* will the player reach a better understanding of the reality?

* will the player attain greater improvement in his process of decision-making?

* will the player acquire the knowledge about the system under study much more rapidly?

* will the player be able to look for the causes behind the effects of his decisions?

I think that, unfortunately, the answer to these questions will not necessarily be affirmative, which is really a pity. If people cannot have access to the structure when playing a game, they will operate just by trial and error as in traditional games, thus very often making decisions based on the symptoms. How useful will the experience acquired by such a method be?

In my view, if we want to use all the potential of System Dynamics, one of the accessible sources of information in games should be the structure which generates the behaviour, at least in the form of the causal diagram. This is our distinguishing feature and it is very important. In such a way, when confronted by certain behaviours after a decision, the player is helped in looking for the underlying causes (reflected in the structure) and in avoiding new decisions based just on the symptoms (the obtained behaviours).

When the person who is leading a game is its creator or, at least, someone who knows the structure of the underlying model, the question is less important. In this case, players can use the game as long as it is judged necessary, their decision-making can be observed, they can try to find out the structure which justifies the observed behaviour and then the leader can confront their hypotheses with the structure of the game. When this happens, the results can be satisfactory.

But this is not always the case; when someone obtains a game, the creator will not be with him when playing. Thus people can imagine erroneous structures ( if they take the time to imagine any) and do not have the possibility of correcting their errors. Or they can symply work with a not exactly erroneous mental model but one different from the model of the structure generated by the game's creator.

The creation and use of games is a new challenge in our field and we are still learning about the way in which people get insights through them. There is a lot of work to be done.

Since September 1990 I have been leading a long-term project with a view to obtaining a "Learning Computer Laboratory for Business management Education" (2). As can be deduced from the title of the project we want to develop a set of System Dynamics models/games (generic and real) as well as to adapt and improve some of the existing ones.

One of our main purposes when developing such tools is to try to help in changing the traditional analytical way followed by most Spanish managers when making decisions. This will be done by means of:

* participation of managers of the sponsoring companies in the modelling process.

* courses for managers and Master students in which the tools developed will play the most relevant role.

Logically, the comments made in previous pages will be taken into account in our project. Nevertheless, we are aware that there is still a lot to be discovered about the learning process with these tools, and so we will organise experimental courses in which we will compare the results obtained by the traditional way of using games (black box games) with the proposed one ("transparent box games" in which the structure of the underlying models will be accessible). This will demand a great deal of time and work but I think that it is worth doing in order to improve our insights into the learning process based on System Dynamics tools.

## NOTES

(1) This paper was presented in the 1990 System Dynamics Conference (Machuca and Roman, 1990)

(2) This project is funded by private companies (Apple Computer España, La Cruz del Campo, S.A., Monte de Sevilla y Huelva), Public Institutions (Instituto de Fomento de Andalucía, Sociedad Estatal Expo'92) and the C.E.E. (COMETT Bureau). We also have the non-financial collaboration of Aeroespatiale (France), ELF Aquitaine (France) and Georg Fischer (Switzerland).

(3) To have a better description of learning laboratories, see Graham and Senge, 1990.

## REFERENCES

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