Lecture for the Japanese System Dynamics Society (Tokyo 8/9/08)

The use of simulators as a means to show managers how to deal with business complexity

by Jose A.D.Machuca

Extended Abstract

It is very difficult for most managers to think "beyond their own factory gate" (Holweg and Bicheno, 2002), which all too frequently leads to only partial solutions to problems being found. However, a well-designed simulator can encapsulate and illustrate fundamental features of the system being studied and allow us to show holistic improvements.

As an example we can take the well known bullwhip effect in supply Chains. This is an interesting example as the difficulty of empirically assessing the cost effects of the bullwhip effect has been frequently stressed. Metters (1997), points out that the relative contribution of the bullwhip effect versus other factors is unclear. He also comments on the difficulty of assessing these costs with analytical closed-form expressions. Apart from this, supply chain management will typically involve managers from three or more organizations, and getting them to work together and participate in a research project can be an extremely challenging affair.

It is important: (a) to specify which part of a problem, here the bullwhip effect, can be attributed to a specific cause (e.g:delays), and (b) to measure the effect of a specific action aimed at its reduction (e.g:EDI). However, as Frangoo and Wooters (2000) have pointed out, this filtering may not be possible. In addition, isolating data for a particular chain can be intractable in practice, since companies can have suppliers and customers outside the defined chain that is being investigated.

A solution to convincing company leaders at all the stages in a chain of the potential advantages of this system would be to demonstrate how the supply chain works in a representative market where the only difference between two successive experiments is the use, or not, of an action(e.g: EDI in our example). Clearly this is impossible in real life. We therefore thought that a simulated market with the

appropriate characteristics could be an effective solution to this problem. This would enable the claimed effects to be measured, not only for the system as a whole, but also for each individual stage of the chain that makes up the system. This point is very important, since it would appear to be necessary to prove that the potential cost reductions and benefits available to each node in the chain justify the costs and effort required to change existing methods and for EDI to be installed at each specific stage. A number of studies show that numerous companies are forced by their suppliers or customers to adopt EDI without having a clear vision of the benefits that it will provide (e.g., Mackay and Malcolm, 1996; Chen and Williams, 1998).

Some of the aforementioned difficulties can be overcome to a large extent by using business simulators. These allow controlled experiments to be carried out in which the values of the variable(s) are manipulated. A laboratory environment of this kind can offer a methodology for supply chain research that otherwise might not be addressed. Another advantage of simulators is that tools of this type compress time and space and permit controlled experimentation, enabling the long-term consequences of current decisions to be tracked.

I would like this presentation to be the basis for a forum of discussion with the members of the Japanese System Dynamics Society.

References

Chen, J., Williams, B.C., 1998. The impact of electronic data interchange on SMEs, summary of eight British case studies. Journal of Small Business Management (October), 68–72.

Frangoo, J.C., Wooters, M.J.F., 2000. Measuring the bullwhip effect in the supply chain. Supply Chain Management 5 (2), 78–89.

Holweg, M., Bicheno, J., 2002. Supply chain simulator—a tool for education, enhancement and endeavour. International Journal of Production Economics 78, 163–176.

Mackay, D., Malcolm, R., 1996. Measuring organizational benefits of EDI diffusion. A case study of the Australian automotive industry. International Journal of Physical Distribution and Logistics Management 26 (10), 60–70.

Metters, R., 1997. Quantifying the bullwhip effect in supply chains. Journal of Operations Management 15 (2), 89–100.