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Developing a GUI Beer Game for Learning and Teaching in Logistics and Supply Chain Management

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Title of project: Developing a GUI Beer Game for Learning and Teaching in Logistics and Supply Chain Management
Type of project: Development

Aims of project

This project aims to develop an IT-based tool with graphic user interface (GUI) to be used in assisting the undergraduate/ postgraduate learning and teaching. The purpose is to facilitate ug/ pg students to better understand the key issues in supply chain (SC) systems, experience the management problems in supply chains, and improve their core skills of supply chain management (SCM).

Background to project

The idea of Beer Game was originally developed by MIT Sloan School of Management in the 1960s and has been played all over the world by people at all levels (http://beergame.mit.edu). The objective of the game is to meet customer demands for cases of beer through a multi-stage supply chain with minimal costs of backorders and inventories. The infrastructure of the supply chain and the rational decision-making process by each player usually lead to creating the bullwhip effect (i.e. small demand variations downstream result in large variations upstream). It is a classic way of experiencing SC inefficiencies and developing skills in managing SCs.

A variety of Beer Game simulations have been developed, e.g. the Web Based Beer Game (http://beergame.mit.edu), the Beergame Portal (http://www.beergame.org). The key problems of using these existing simulations are: (i) they are often constrained by licences; (ii) although some of them are claimed to be free for education users, the installation requires specific supporting software and hardware, which may be not available at the UoP; (iii) more importantly, the existing tools have a fixed configuration, make various assumptions, lack the flexibility to serve our purposes in terms of structure, parameters, decision-making, data format, and analysis; (iv) they cannot incorporate our new research findings in this area, which constrains the implementation of research-based learning method. It is therefore desirable to develop our own GUI Beer Game tool that can closely link our research outputs with teaching, and enhance the quality of learning and teaching in logistics and SCM at the UoP.

Game-based learning has been an important method in modern education, e.g. many lecturers in Plymouth Business School and School of Engineering are using either in-class board games or IT-based simulation games in their teaching. The experience accumulated during the development of the IT-based tools is also valuable to other staff

and disciplines, e.g. other subjects in Business School and some subjects in Engineering School.

Methods used
This project is carried out as follows: (i) based on systematic literature review, previous students' requirements, in-class board game practices, the existing DOS-version of the Beer Game, and our recent research findings, an appropriate GUI Beer Game is structured and designed in concept; (ii) an RA is recruited to code the GUI Beer Game tool using Microsoft Visual Studio, which ensures that the tool can be run on any UoP PC without additional investment; (iii) testing and validating the GUI tool using a variety of examples; (iv) piloting the tools by selected students; (v) evaluating and applying the new tool in ug/ pg learning and teaching as part of their coursework.

Results
A PC-based GUI Beer Game has been successfully completed in this project. It consists of two versions, a teacher's setup version and a student's execution version. The teacher's setup version has the full functions with the flexibility to create various student's executable versions according to scenario requirements, whereas the student' version has the fixed structure to serve specific purposes. In this way, the intellectual propriety of the tool can be protected to some extent since the students are only using the execution version. The teacher's version has the following unique features compared with the existing Beer Games in the literature:

- Flexible supply chain structure with changeable numbers of entities
- Flexible lead-times of information flow and shipment flow between entities
- Flexible types of uncertainty in customer demands
- Flexible cost parameters to simulate different business scenarios
- Including both interactive and purposely-designed decision-making mechanisms
- Flexible design to incorporate our research results into the game
- Experiment results are outputted so that students can perform own statistic analysis
- Runnable at any UoP computers without installing additional supporting software

The tool has been tested using many scenarios by the research team. It was also piloted by a few postgraduate students. The tool will be validated and applied in learning and teaching at ug/pg level in the coming academic year. The licensing and copyright issues will also be considered with the help of R&E department in the future.

Associated publications
Song, D.P., Shunmugham, P. and Rong, F. (2010), Developing a GUI Beer Game for Learning and Teaching in Logistics and Supply Chain Management, Presented at *the VC's Teaching and Learning Conference*, University of Plymouth, June 30th, 2010.

Website: N/A

Keywords: IT-based learning; simulation game; role playing; problem solving.

Appendix -- Information/progress on conditions

The following responds to the comments/ conditions made to the initial proposal:

- *The literature base needs to be strengthened, especially in terms of teaching and learning and using 'games' to learn.*
- *Include stronger justification in terms of teaching and learning (the strategy, the benefits to students learning experience, etc.)*
- *Include plans for dissemination beyond the subject discipline; it is currently too subject focussed.*

Response to above three points:

Game-based learning has been an important method in modern education, e.g. many lecturers in Plymouth Business School and School of Engineering are using either in-class board games or IT-based simulation games in their teaching.

The Beer Game has been proved to be a classic and effective way of experiencing supply chain inefficiencies and developing skills in managing supply chains. It has been played all over the world by people at all levels, from high school students to presidents of big multinational groups. IT-based learning and teaching is one of the important strategies for the UoP as an enterprise University. For example, the UoP has become a member of the SAP University Alliance, which enables students to involve hands-on experience of using professional business software: SAP. The SAP certification could enhance the employability of students. The development of GUI Beer Game is in alignment with our University's strategy.

The experience accumulated during the development of the IT-based tools is valuable to other staff and disciplines, e.g. other subjects in Business School and some subjects in Engineering School. The argument is that logistics and supply chain is a multi-disciplinary subject that may be covered in many subjects, e.g. operations management, business management, shipping and logistics, transport engineering, industrial engineering, manufacturing engineering, control engineering, and mechanic engineering.

A presentation of the work has been given in the VC's Teaching and Learning Conference in June 2010. A working paper based on this project is under preparation. It is planned that the results and experience will be disseminated through seminars, conferences, and journals in a wide range of communities.

- *Develop a more detailed Plan of Work.*

Response:

Due to the delay caused by HR handling the recruitment of the RA (the RA was in place four months later than planned), the initial work plan was adjusted accordingly.

A PC-based GUI Beer Game has been successfully coded, tested, and piloted. The only task that was planned but not completed is to evaluate the tool through the MSc students as part of their coursework in the second term of the 2009/2010 academic

year. The reason is that the tool was completed near the end of April 2010 due to the delay in employing the RA, which makes that task infeasible. However, the tool was evaluated by a few postgraduate students and good feedback was received. We plan to apply the tool to ug/pg learning and teaching in the next academic year for more evaluation.

It should be pointed out that one added value in this project is that the RA delivered two versions of the tool, a teacher's version and a student's version. The teacher's version is able to create different student versions. In terms of further research, a very interesting direction is to develop a Server-Client Beer Game, which would allow several students to play the same game simultaneously. This would significantly improve the applications of the tool in learning and teaching. Hopefully, this could be done in the future project.

- *Consider licensing and copyright issues.*
- *Provide further information on Evaluation of impact.*
- *Demonstrate how this links to Enterprise.*

Response to above three points:
The copyright of the tool is clearly shown at the beginning of the game. The student' version of the tool has the fixed structure and rather limited function. Therefore the intellectual propriety of the tool can be protected to some extent. The licensing and copyright issues will be considered further with the help of R&E department at the University of Plymouth.

Because the tool was finished near the end of April 2010, the evaluation of the tool through the MSc students as part of their coursework was infeasible in the 2009/2010 academic year. However, the piloted evaluation of the tool has been done by a few postgraduate students. They provided with positive comments, in particular, compared with the DOS-version and some existing beer games. The feedback revealed that our tool has a better GUI with clearer display, and easier to understand and operate. More detailed evaluation in a larger scale will be pursued in the 2010/2011 academic year.

Through the application of the tool in ug/pg learning and teaching at UoP and revising the tool according to students' feedback iteratively, there is a possibility to enterprise the tool to external communities. In this aspect, we may require helps form R&E Department on the issues such as licensing and other enterprising formats after further development.

**Appendix – poster presentation at VC's Teaching and Learning Conference 2010
Developing a GUI Beer Game for Learning and Teaching in Logistics and Supply
Chain Management**

Dr. Dongping Song, Dr. Pandian Shunmugham, Dr. Rong Fu
Plymouth Business School, University of Plymouth

- This project developed an IT-based tool with graphic user interface (GUI) to
  facilitate students to better understand the key issues in supply chain (SC)
  systems, experience the management problems in SC, and improve their core
  skills of SCM. The tool will differentiate itself from the literature in the following
  aspects:
    - Flexible SC structure with changeable numbers of entities
    - Flexible lead-times of information flow and shipment flow between entities
    - Experiments with different types of uncertainty in customer demands
    - Flexible cost parameters to simulate different business scenarios
    - Including both interactive and purposely-designed decision-making
      mechanisms
    - Flexible design to incorporate our research results into the game
    - Easy-to-handle output data, which enables students to perform statistical
      analysis easily
    - Runnable at any computers at UoP without installing additional supporting
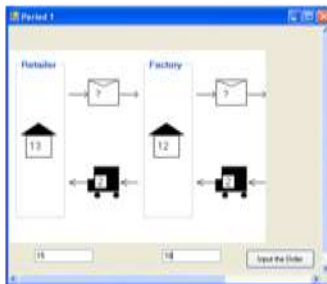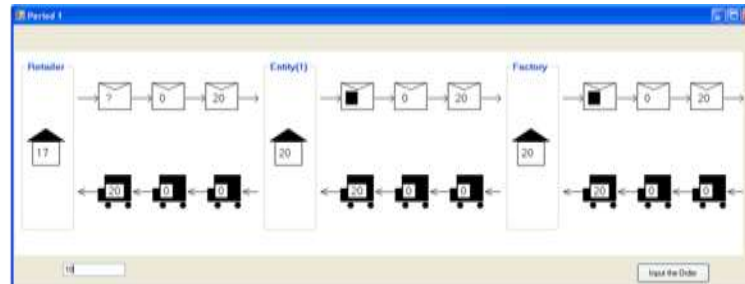   software

Fig. 1 Two stage SC
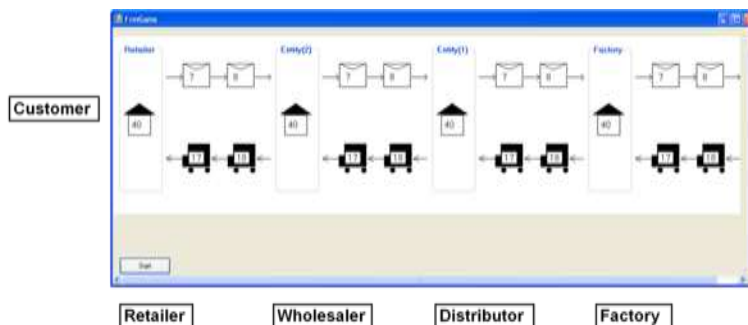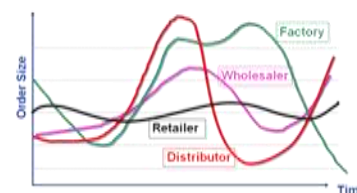

Fig. 2 Three stage SC

Fig. 3 Four stage SC

Fig. 4 Bullwhip effect in SC

Challenge of the Beer Game: How to manage the entire supply chain effectively,
i.e. meeting customer demands and keeping low inventories?