Int j simul model 8 (2009) 2, 102-113
ISSN 1726-4529 Professional paper

WEB-BASED SIMULATION OF MANUFACTURING SYSTEMS

Kehris, E.
Technological Education Institute of Serres, Terma Magnisias, 621 24 Serres, Greece
E-Mail: kehris@teiser.gr

Abstract
Powerful new features may be incorporated to simulation environments by exploiting existing Web technology. To demonstrate this, WebManSim, a prototype web-based manufacturing system simulator has been developed. The proposed system includes project management principles, supports communication and voting and provides workflow facilities and simulation program generation - execution capabilities. Such a system provides close monitor to the evolution of the simulation project, enhances the coordination and communication of the simulation participants, identifies and resolves conflicts that may arise in the simulation team and creates virtual simulation expert communities. The use of such a system may improve the simulation team coordination by automatically initiating project tasks as soon as possible, reduce the project duration by eliminating dead time between activities and decrease the overall simulation project cost by minimizing the face-to-face meetings especially when used by project teams located at geographically remote places.
(Received in August 2008, accepted in January 2009. This paper was with the author 2 months for 1 revision.)

Key Words: Web-Based Simulation, Simulation Project, Groupware, Manufacturing Simulators

1. INTRODUCTION

Simulation is applied to a wide range of domain areas when decision making is required while analytical methods are oversimplified and the cost or danger of experimentation directly with the physical system is high. Simulations are team effort projects which evolve through a number of activities. Domain area experts, decision makers, simulation analysts and programmers form the simulation team and are often located at geographically remote places.

The co-ordination of the simulation team members lies within the responsibility of the project manager and is crucial for the success of the project. In this paper we investigate the problem of using web technologies in order to automate the coordination of the members involved in the simulation of manufacturing systems. In order to address this problem, we have developed a web-based simulation environment that enhances the co-ordination of the members of a simulation project by automatically activating the activities in which they are involved. Although the environment we present is dedicated to the simulation of manufacturing systems, the ideas put forward have a wider impact and may be easily applied to other simulation areas. We demonstrate that the proposed simulation environment which combines project management principles, workflow features, groupware facilities and simulation program development capabilities improves the monitoring of the progress of the simulation project and automates the co-ordination of the work of the simulation team members.

The design of the proposed system was influenced by the key findings of the following research questions posed during the initial phases of this work:

- Who are involved in the simulation of a manufacturing system, what is their expertise and which are their tasks in the simulation project?
- What coordination techniques may be employed in a simulation project?

- simulation analysts pointed out that they felt restricted by the fact that the simulation was carried out in a specific language,
- operators indicated that they would prefer to explain the functionality of the workstations they operate on site rather than describe it in text as required by the system.

The third of the above mentioned comments may be addressed in future extensions of the system. For example, additional code generation modules may be incorporated to the system that will allow the user to choose the language or the library in which the simulation program will be developed. Similarly, web-based modelling editors may be incorporated in WebManSim in order to facilitate the program development: simulation analysts could use a modelling editor to describe the behaviour of manufacturing entities not yet simulated by the system while the editor could automatically generate the appropriate code to simulate the manufacturing entity.

The fourth point raised by the operators highlights a general issue related to the acceptance of the software by the users. In a simulation project that point should be addressed by the project moderator at the initial stage of the project by careful selection of the members of the simulation team and sensible assignment of tasks to each participant.

5. ACKNOWLEDGEMENT

This Project is co-funded by the European Social Fund and National Resources - (EPEAEK-II) ARHIMIDES.

REFERENCES

[1] Yalcin, A; Namballa, R K. (2005). An object-oriented simulation framework for real-time control of automated flexible manufacturing systems, *Computers & Industrial Engineering*, Vol. 48, 111-127

[2] Filho, W. A.; Hirata, C. M.; Yano, E. T. (2004). GroupSim: A collaborative environment for discrete event simulation software development for the World Wide Web, *SIMULATION*, Vol. 80, No. 6, 257-272

[3] Anderson, M.; Grimm, H.; Persson, A.; Ng, A. (2007). A web-based simulation optimization system for industrial scheduling, *Proceedings of the 2007 Winter Simulation Conference*, 1844-1852

[4] Law, A. M.; McComas, G. (1989). Pitfalls to avoid in the simulation of manufacturing systems, *Industrial Engineering*, May, 28-31

[5] Robinson, P. M.; Pidd, M. (1998). Provider and customer expectations of successful simulation projects, *Journal of the Operational Research Society*, Vol. 49, No. 3, 200-209

[6] Wilcox, P.; Pooley, R. (1998). Factory simulation across the World Wide Web using Java, *Proceedings of the 1998 International Conference on Web-Based Modelling and Simulation*

[7] Taylor, S. J. E. (2000). NetMeeting: a tool for collaborative simulation modeling, *Int. Journal of Simulation, Systems, Science and Technology*, Vol. 1, No. 1-2, 59-68

[8] O'Keefe, R. M.; Haddock, J. (1991). Data-driven generic simulators for flexible manufacturing systems, *International Journal of Production Research*, Vol. 29, No. 9, 1795-1810

[9] Taylor, S. J. E.; Robinson, S. (2006). So where to next? A survey of the future for discrete-event simulation, *Journal of Simulation*, Vol. 1, No. 1, 1-6

[10] Crookes, J. G. (1989). Simulation using C, in *Computer modelling for discrete simulation*, edited by M. Pidd, John Wiley, New York

[11] Kehris, E.; Doulgeri, Z. (1998). An FMS simulation development environment for real time control strategies, paper presented at the *16th European Conference on Operational Research*, Brussels