

GRAND CHALLENGES IN MODELLING AND SIMULATION OF LOGISTICS SYSTEMS

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ABSTRACT

In this presentation, we discuss the applicability of the grand challenges identified by Fowler and Rose to the logistics systems and review their progress. In addition, we bring out some new challenges that impede the application of modelling and simulation in logistics systems. We will also discuss the possible measures and developments that will help counter these challenges.

1 INTRODUCTION

Modern logistics systems are a complex integration of man and machine. The presence of various types of manual and automated equipment in these logistics systems increases this complexity. The logistics systems have been dependent on “gut feeling” and “thumb rules” for far too long. However, global expansion of supply chains and the rise of e-commerce that are characterized by agility, speed, and accuracy of delivery have necessitated the use of formal models. Modelling and Discrete Event Simulation (DES) of these diverse logistics systems are becoming a necessity in evaluating the performance (Fowler and Rose, 2004). In fact, there is a need to develop multiple models to solve multiple challenges in these logistics systems. Simulation models present an easier approach to test the integration of various sub-systems and to study their mutual interactions. It is easier to study systems in their digital avatar before spending the money to actually build them in real life. Simulations also help in evaluation of different systems in same environment or same system in different environments (Yucesan and Fowler, 2004). Although these simulation models are more capable and suitable in answering the complex questions on performance of these systems, they require much more computational power (Monch et al., 2011). As a result of a 2002 Dagstuhl Seminar (Fujimoto et al., 2002), Fowler and Rose (2004) discussed grand challenges in the modelling and simulation of complex manufacturing systems. Similarly, there are certain grand challenges associated with the use of modelling and simulation in the logistics systems. They are listed below.

2 GRAND CHALLENGES

Grand Challenge 1: Time taken to build a Simulation Model

Grand Challenge 2: Too much data, Too little data

Grand Challenge 3: Real time connectivity of the Simulation model to the Physical System

Grand Challenge 4: Reusability and Interoperability of Simulation Models

Grand Challenge 5: Variabilities in Logistics System compared to other Systems

Grand Challenge 6: What is the right fidelity level needed for solving the problem?

Grand Challenge 7: Awareness in the Industry about Simulation Modelling

3 CONCLUSIONS

Each of the grand challenges listed above will be discussed in greater detail during the presentation at the conference. The current status of the research in the area of these challenges will also be reviewed.

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REFERENCES

- Monch, L., Lendermann, P., McGinnis, L. F., and Schirrmann, A. 2011. A Survey of Challenges in Modelling and Decision-Making for Discrete Event Logistics Systems. *Computers in Industry*, 62(6), 557-567.
- Fowler, J. W., and Rose, O. 2004. Grand Challenges in Modeling and Simulation of Complex Manufacturing Systems. *Simulation*, 80(9), 469-476.
- Yucesan, E. and Fowler, J. 2000. Simulation Analysis of Manufacturing and Logistics Systems. *Encyclopedia of Production and Manufacturing Management*, Kluwer Academic Publishers, Boston, P. Swamidass ed, 687-697.