New Challenges in Supply Chain Management Simulation: Competitiveness vs. Sustainability

by

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The talk is aimed at providing an insight into modern approaches to simulation-based analysis of supply chains. It gives an overview of using Modeling and Simulation (M&S) for facing different types of activities in supply chain management. Modern tendencies of simulation-based supply chain management are considered, in particular, covering the following criticality:

• **Sustainable Logistics**

The financial crisis (started at the beginning of 2008) has created a “new reference scenario” for leading companies operating in global markets; in effects, the recent financial crisis in western countries requires a complete rethink of industrial and logistics processes sustainability; the financial crisis is afflicting the main industrial sectors (automotive, transports and distributions, high-tech, etc.) and it is now evident that current models for industrial and logistic operations management are not able to sustain the economic development. Sustainability is becoming the major concern of engineers and managers and the most important companies’ goal to achieve in the medium-long term. In particular, the industrial and logistic processes evolving in the global supply chain have to face difficulties related to the increase of the energy, manpower and production costs, to suppliers’ failures and to the absence of liquid cash. Due to these considerations and considering that quantitative models must be able to recreate the whole systems evolution over the time, the authors believe that simulation actually represents the only methodology to support the achievement of future outputs consistent with companies’ long term desired values. Simulation can be used for predicting systems evolution on a predetermined time horizon on the basis of historical data and considering the interactions of different critical factors and their effects and consequences.

• **Green Logistics**

“Green Logistics” concept born several years ago and originally was very strongly related to qualitative considerations devoted to improve the sustainability of logistics. A new approach to Green Logistics is devoted to developing new models to support quantitative analysis and to measure the real impact of the whole supply chain; such an impact affects sustainability and represents indirect costs and consumption of resources. The M&S approach seems to be the ideal one in Green Logistics in order to consider various aspects and a wide set of different elements that sometime are not easy to be recombined. For instance, the conceptual model needs to include direct and indirect emissions of different types as well as estimation of other waste disposals (i.e. rubber due to tire consumption) and infrastructure effects (i.e. highway or rail occupancy). On the other hand, concerning with the long term target functions, it is necessary to use simulation for estimating future state of the
system by conducting experimental analysis on the models. In fact the long term impact of actual actions, due to the inertia of the real system, requires adopting simulation as forecasting methodology in order to develop a predictive control, aiming to provide sustainable supply chain development.

- **Supply Chain Resilience: ASPID**

This research is looking forward to develop innovative tools for analysis and optimization of risk related to evolution supply chain management. ASPID (Advanced Supply chain Protection & Integrated Decision support system) proposes an innovative use of M&S for evaluating the impact on the supply chain of different aspects such as international competition, know-how diffusion in new areas, critical events and disasters. The goal of ASPID is to develop innovative decision support systems oriented to risk analysis and supply chain resilience optimization, in order to support the growth of the enterprises. The concept of resilience applied to a supply chain, intended as the capability of a system to come back to its equilibrium position (or to shift to a different and more desirable position of equilibrium) after a disturbing action, recalls the ideas of agility, flexibility, velocity and visibility. In fact, it's easy to realize that elements as the capacity to rapidly answer to variability and sudden changes in markets, lead times minimization, the creation of faithful relationships to extend along the whole logistic chain, a correct management of information become fundamental to promote resilience and safety in supply chains.

- **Quick Response**

The Quick Response approach in supply chain management is demonstrated using the case of the fresh food retail sales market that represents a business that is quickly growing-up with constant shift of the scenario from a large range of little single stores to a restrict numbers of big companies and cooperatives. These more complex structures make it possible to better cover market requests saving costs, driving processes to a re-organization and optimization (i.e. centralization of administrative activities, intelligent selection of suppliers, etc.) but needing small lead time in decision making in more structured problems. In the considered case, the discrete-event system simulation provides re-organization of the logistics scenario permitting a better synergy between the quality control level, goods flows plotting and cost saving, giving added value to processes and activities.

- **Logistics Bottleneck Saturation**

Some quick example of logistics process analysis is proposed in reference to industrial cases devoted to demonstrating the potential of simulation. In particular, the “Design of Experiments” technique is applied to simulation models for completing sensitivity analysis and identifying logistics bottlenecks within industrial plants.

- **Simulation in Supply Chain Management**

The role of simulation in supply chain management is discussed. Different supply chain simulation approaches are considered, in particular, discrete-event simulation and system dynamics.

- **Supply Chain Dynamics**

Different aspects of increasing demand uncertainty through an entire supply chain are considered, starting with sources of this phenomena (also called “Bullwhip effect”), and concluding with possible approaches to diminishing its negative consequences. Simulation-based analysis of the role of sharing information along a supply chain is discussed.

- **Simulation-Based Training in Supply Chain Management**

Experiences in using simulation-based business games for training and education in the area of supply chain management are discussed. A state-of-the art review of extant application of simulation games used for training and education in supply chain management is presented. It is followed by discussing exploitation of both computerized and manual versions of the widely used Beer Game. Finally, the recently developed ECLIPS game
is presented. It has been developed within a European project for providing an insight into various aspects of supply chain management, with possibilities to analyze different supply chain structures and control mechanisms. In particular, application of the ECLIPS game to comparison of different supply chain inventory management policies, including non-cyclic and cyclic ones, is provided. For that particular situation, game rules and playing process are explained, as well as sample results of using the game are presented and interpreted.

Biography of the Speakers

Agostino Bruzzone is Full Professor at University of Genoa, Director of the Genoa Center of the McLeod Institute of Simulation Sciences (MISS, an Institution with over 25 Centers distributed worldwide: China, USA, UK, Italy, France, Germany, Canada etc.) President of the Liophant Simulation, Member of the Board of MIMOS (Movimento Italiano di Simulazione), member of the Society for Modeling and Simulation International (SCS).

His field of interest is simulator-based applications for industrial plants, developing new methodologies and intelligent system integration techniques. He gives lectures on “Project Management” and "Industrial Logistics” and he has utilized extensively simulation techniques in harbour terminals, maritime trading. He has been actively involved in the scientific community from several years as Associate Vice-President and Member of the Board of the Society for Modelling & Simulation International, Italian Point of Contact for the ISAG (International Simulation Advisory Group) and Sim-Serv. He acquired extensive experience as a member of International Technical and Organization Committees and as a general coordinator of scientific projects (i.e. General Chair of "Summer Computer Simulation Conference", "International Mediterranean Modelling Multiconference" and “Web Based Simulation Conference”, Program Chair of the “Workshop in Harbour and Logistics Modelling”, Guest Editor for “Special Issue of Harbor and Maritime Simulation” in Simulation). He was involved in different Projects as Project Manager or Scientific Responsible such as: FLODAF (Fuzzy Logic Data Fusion Italian Navy), HLA University Outreach Program (DoD, Defense Modeling & Simulation Office, McLeod Institutes of Simulation Sciences). As international expert, he was active in the development of NATO project NIAG SG60 (Simulation Based Design and Virtual Prototyping, NATO). He is Genoa Site Director of the Genoa Centre of the McLeod Institute of Simulation Science.

Yuri Merkuryev is Habilitated Doctor of Engineering, Full Professor at the Institute of Information Technology of Riga Technical University (RTU), Head of the Department of Modelling and Simulation. His professional interests include both methodology and practical implementation of discrete-event simulation, supply chains modelling and management, and education in the areas of simulation and logistics management.

Prof. Merkuryev is regularly participating at both national and European research and educational projects in the areas of IT-supported logistics management. In particular, his experiences include coordinating a research grant from the Latvian Council of Science, aimed at development of simulation-supported educational tools, as well as leading an RTU group within the European research project ECLIPS, aimed at development, simulation-based validation and practical implementation of advanced supply chain management algorithms.

Prof. Merkuryev is member of the Simulation Team, Director of the Latvian Centre of the McLeod Institute of Simulation Sciences (MISS) of the Society for Modeling and Simulation International (SCS), SCS senior
member, Board member of Federation of European Simulation Societies (EUROSIM), member of the Liophant Simulation Club, President of Latvian Simulation Society, and corresponding member of the Latvian Academy of Sciences. He is IEEE member and IT professional Fellow of the British Computer Society.


Prof. Merkuryev is regularly involved in the organization of international conferences in the simulation area. He was General Conference Chair for international conferences “Harbour, Maritime, & Multimodal Logistics Modelling and Simulation”, HMS 2003 and The European Conference on Modelling and Simulation, ECMS 2005, and General Co-Chair of HMS 2008-2011. He is serving as General Co-Chair for The 9th International Multidisciplinary Modeling & Simulation Multiconference, I3M 2012 that will be held in Vienna, Austria in September, 2012.