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**Sim-Serv Working Group:
Roadmap for Discrete Event Simulation in European Industry
Meeting point: Hotel Monopol, May 27, 2004**

Participants

Mr. Walczak,	CAMT
Prof. Bruzzone,	University of Genoa
Prof. Christova,	University Sofia
Dr. Chrobot,	CAMT
Dr. Echave	Unidad de Oganizacion de la Produccion
Dr. Krauth,	Sim-Serv, SDZ
Prof. Noche,	University Duisburg-Essen, SDZ
Prof. Pierreval,	IFMA
Dr. Splanemann,	Degussa

Agenda

9.00 h Welcome, introducing attendants
9.30 h Report of first meeting
10.00 h Applications and requirements of chemical industry
11.00 h Break
11.30 h Applications and requirements of other sectors
 - Retail and maintenance centres
 - Car manufacturing
 - Traffic applications
13.00 h Lunch
13.45 h Alternatives to simulation
14.00 h Commonalities of the applications and requirements discussed in the morning
15.00 h Break
15.15 h Open discussion
16.00 h Next steps
16.30 h Closing the meeting

Introduction of attendants

The participants presented themselves. Especially the new participants introduced their activities and special areas of interest. New participants: Dr. Echave, Prof. Pierreval

Report of first meeting

- Introduction into the task of the roadmap
- Repetition of some aspects for the installation of the working group
- Review of the discussions of the first meeting
- Agreement on the tasks of each participant
- Review of the minutes of the meeting from April 8th, 2004.

Applications and requirements of chemical industry

The situation of discrete event simulation in chemical industry was discussed. Especially the points listed in the first meeting were reviewed. Dr. Splanemann (Degussa) explained special aspects of the applications in chemical industry.

As a summary the following conclusions can be made:

- Discrete event models are needed and used in chemical industry
- There is an expansion of tools applications not only concerning simulation but in general for computational methods
- A standardization of model elements would be highly appreciated
- The simulation tools should provide a variety of additional capabilities such as:
 - rely on a product database
 - incorporate scheduling functionality
 - provide appropriate result figures
 - offer validation functionality
 - offer connectivity to other computational methods
 - support design of experiments

Simulation in chemical industry serves as a repository for knowledge about best practice. It becomes clear that advances in simulation software and consultancy will not be funded by applicants. It was (and still is) expected that suppliers of software offer further developments which are a direct response to the needs of the customers.

Applications and requirements of other sectors

There were identified three other sectors of interest: Distribution systems, Manufacturing systems and traffic systems.

For distribution systems a series of questions and modelling elements were identified.

General questions:

- Bottlenecks, weak points, rationalization potentials
- Performance of distribution centers
- Throughput of orders
- Organisation of order processing, shift models
- Organisation of persons (including qualification)
- Warming up, initial situation
- Breakdowns, restart of system
- Empty boxes
- Special situations and orders
- Order picking and packaging
- Scenarios

Typical modelling elements:

- Stores, storing areas, buffers
- Order picking principles
- Conveyors (different techniques and elements)
- Workstations (packing, wrapping, preparing, loading etc.)

- Shift models
- Utilisation of persons (employees)
- Routes and time tables
- Breakdowns
- Operation rules (order processing)
- Consolidation and set building areas

Further developments of the application of simulation in distribution systems should be concentrated on:

- Verification of the models on logical errors
- Elaboration of control and process strategies
- Proof of functionality in the realisation step

Within the discussion some important needs were mentioned:

- Means for assigning articles to storing areas
- Design rules for storing systems, picking areas, consolidation systems
- Algorithms for operating the systems
- Rough calculations for proving the results
- Mechanisms for checking the models
- Means for improvement of explainability of results
- Tools for visualization and animation, not only of layout based components but also data structures and operation rules
- Appropriate optimization techniques
- Sensitivity analysis for new order structures
- Robustness analysis for distribution systems where the utilization is shared between different customers
- Procedures for using simulation during acceptance
- Simulation models as part of decision making in the life cycle of a distribution system
- Model elements for operating distribution systems
- Help during construction and installation of equipment

These developments are needed for an efficient use of the simulation technology during planning steps. There are still a variety of open points for the application of the methodology for the operation of the systems and test of functionality during the construction phases.

For traffic systems a project was presented and discussed in detail. It was decided that traffic systems are not a central part of this working group (there exists a special working group for traffic systems).

For manufacturing systems a first short discussion was made. It was concluded that additional work should be done after the meeting by Dr. Echave.

Alternatives to simulation

Prof. Christova presented a paper about the “Theory of Generalized Nets”. They are extensions of Petri nets and offer special characteristics. Additionally it is stated that the Generalized Nets could be used for solving the following problems:

- Optimal scheduling of raw materials ferrying
- Optimal loading of machines
- Checking of optimal capacities of connected elements of the manufacturing
- Determination of waiting times of machines

It is clear that also other methods can be applied such as mathematical modelling, queuing theory etc. They should be described in a special white paper.

Next steps

On the basis of the discussions it was decided to write the following white papers:

- Basic introduction
- Distribution systems
- Manufacturing systems
- Chemical systems

- Traffic systems
- Simulation and scheduling
- Alternatives to simulation
- Meta-modelling

The papers should be written by a group of authors and consider the discussions of the meeting group.

Additionally a list of articles about simulation should be provided giving an impression of the current state of the art.

Attachment: List of articles, Slides of IMTI-report

Prof. Dr.-Ing. Bernd Noche

Title	Author	Source
LESNEX: Lean Simulation Network of EXcellence		www.liophant.org/lesnex
Information structure to support discrete event simulation in manufacturing systems	Björn Johannson, Joacim Johnsson, Anders Kinnander (Chalmers University of Technology, Gothenburg, Schweden)	Winter Simulation Conference 2003
Innovating Shoe Manufacturing using Advanced Simulations Techniques	Emanuele Carpanzano, Andrea Cataldo (ITIA-CNR laboratori of Vigevano, Italien)	www.ercim.org/publication/Ercim-news/EN56.pdf
A Simulation of ECN-Capable multicast multimedia delivery in NS-2 Environment	Robert Chodorek, AGH (University of Technology, Krakau, Polen)	www.scs-europe.org/services/ess2002/PDF
Reverse-Time simulation in production line redesign	Jaap A. Ottjes, Gabriel Lodewijks (Delft University of Technology, Niederlande) Kees Meeusen, Wouter O. Hubert van Blijenburgh (Fast&Fluid Management, Unit of IDEX Corporation, Niederlande)	www.scs-europe.org/services/ess2002/PDF
How simulation can help in a process control model	Franck Théroude, Christian Braesch, Alain Haurat (LISTIC, Ecole Supérieure d'Ingénieurs d'Annecy, Frankreich)	www.scs-europe.org/services/ess2002/PDF
A fast and efficient model of an MPEG-4 video traffic based on phase space linearised decomposition	Agnieszka Chodorek (Department of Telecommunications and Photonics, Kielce University of Technology, Kielce, Polen)	www.scs-europe.org/services/ess2002/PDF
Warehouse layout design: Minimizing travel time with a genetic and simulative approach – Methodology and case study	Filippo Queirolo, Flavio Tonelli (DIP, University of Genoa, Italien) Maurizio Schenone (DSPEA, Polytechnic of Turin, Italien) Paolo Nan, Ivan Zumino (SACS Savona, Italien)	www.scs-europe.org/services/ess2002/PDF
Holonic order management for large-scale automated logistic systems	Corné Versteegt, Alexander Verbraeck, Martijn Verschuren (Systems Engineering Group, Faculty of Technology, Policy and Management, Delft Universität, Niederlande)	www.scs-europe.org/services/ess2002/PDF
An application of simulation and value stream mapping in lean manufacturing	Yang-Hua Lian, Hendrik Van Landeghem (Department of Industrial Mangement, Ghent University, Belgien)	www.scs-europe.org/services/ess2002/PDF
Simulation of operation of a medium sized seaport. Case study: Port of Gdansk	Andrzej Dzielinski, Krzysztof Amborski, Przemylaw Kowalczyk (Institute of Control&Industrial Electronics, Warsaw University of Technology, Warszawa, Polen)	www.scs-europe.org/services/ess2002/PDF
Job sequencing problem in a semi-automated production process	Roberto Mosca, Filippo (Department of Production Engineering, University of Genoa, Italien)	www.scs-europe.org/services/ess2002/PDF