

The World's First Virtual Centre for Simulation



Sim-Serv Survey

**Developing Uses of Simulation in Supporting
Business Enterprise Requirements**

February 27, 2003

Sim-Serv

1.0 Introduction

This report provides an insight into the areas where simulation applications appear to be prevalent and those where developments may be anticipated in the near future. As such, it provides an input into the Sim-Serv working groups.

2.0 Overview

Sim-Serv has now made contact with a first group of potential users of its services and the indications are that our network of suppliers is well able to meet the demands of manufacturers. The present report provides a preliminary assessment of where technological development may be required in the future and it is hoped that its findings may be used by the Technology Working Groups to provide a directional steer.

3.0 Applications in Test Cases

The areas of application finding favour in the nine test case projects so far underway or agreed in principle may be classified as;

1. Human Aspects – maximizing the utilization of human resources in new or changing manufacturing scenarios. Planning career development using models and systems theory.
2. Product Development – utilisation of simulation models to enact aspects of new manufacturing processes or to select from alternative manufacturing scenarios.
3. Planning and Scheduling – reduction of lead times, intermediate and final product stocks by more effective prediction of manufacturing patterns to satisfy short-term orders.
4. Manufacturing Logistics – improved cycle times supported by optimized flows of intermediate products, resulting in improved plant velocity.
5. Modelling of Energy Consumption – simulation at holistic level to ensure high overall efficiency and avoid wastage.

In analyzing this listing it may be said that items 1&2 are rather specialized. In both these areas there are worthwhile savings to be made by use of simulation, but at the present time, its application is rather novel. The recommendation is that Sim-Serv actively promotes the results of test applications here and stimulates wider-spread take-up in the future.

Turning to 3&4, it may be said that the return on investment for simulation applications in these areas is usually very considerable. They may be considered as the heartland of manufacturing simulation and Sim-Serv must therefore maintain a high profile on its capabilities in these areas. Indeed, it is likely that these aspects will form the spearhead of commercial applications in the months to come.

The final aspect (5) provides a strong pointer to the direction in which things will develop in the future. The issue is holistic modeling of a relatively complex infrastructure, with analysis and optimization. Whist, energy is a most worthy parameter for such optimization, the opportunity may be seen also, for maximizing the performance of overall business performance in much the same way. The Sim-Serv team sees this as an important direction for the future and we present below some of the requirements which will require development. Our expectation is that these will form the basis for a separate, but complementary, development project of the future.

4.0 Technology Development for Future

Overall, the objective is to contribute towards improving,

- Efficiency and Integrity of carrying out Manufacturing Operations
- Ease, Speed and Effectiveness of surrounding Business Processes
- Cash-to-Cash Cycles and Value Chain Integration
- Integrated Performance of Holistic Business Activities, with On-Line Optimisation

At first glance, it would seem that these areas for improvement are diverse. Nevertheless, they may all be supported by the very tangible and common, enabling technologies surrounding effective flows of Knowledge and Information. Such techniques are all-pervasive across the full vista of manufacturing business and require to be deployed within an industry-wide infrastructure in order to achieve anything like maximum impact.

It is recognized that the above objectives are at the level of “business imperatives”, and there has to another layer of solid research and development activities underpinning these. The requirement is for dynamic R&D, driven forward by ongoing business requirements. The essential elements are outlined below with additional information in Appendix 1.

- (I) ICT working in Real, or Near, Real Time.**
- (II) Open Communications and Software.**
- (III) Effective Flows and Portability of Knowledge.**
- (IV) Restructuring of Organisations and Resources.**
- (V) Control and Optimisation of Business Processes and Overall Business Systems.**

5.0 Conclusions

1. It may be deduced from the technology deployed in current test cases and discussed for other possible applications, that Sim-Serv is well able to meet the majority of current generation needs from European manufacturers.
2. The implication is that the expertise held within the network of suppliers is relevant and at the right level of sophistication.
3. The area of Planning, Scheduling and Manufacturing Logistics are the ones where there exists a particularly strong industrial demand and where the impact on the bottom line will be truly significant. This should be regarded as the Sim-Serv heartland around which cost-effective commercial services may be built up in the succeeding months.
4. Developments for the future are judged to be associated with a move to solving more holistic problems, effectively using real time modeling and taking advantage of massively increased data/information flows in the future. There is a strong case for Sim-Serv/ Max-Serv (<http://www.max-serv.com>) becoming involved in R&D work around this theme with a view to achieving a unique and highly valuable capability for the future.

Appendix 1

DESCRIPTION OF THE RESEARCH ACTIVITIES AND AREAS

(I) ICT working in Real, or Near Real Time

The aim of the work here is to provide in real time, or near real time (small delays in the acquisition of data) useful information, diagnostics and up to the minute information on key Business and Process Metrics, which supported by simulation and decision making tools will enable the fast testing of scenarios and improve management responsiveness. The use of a holistic, systems based approach supported by appropriate formal modelling tools and methods of analysis (contrary to current ad-hoc methods) is a major innovation. The distinguishing feature in this area of work is that we deal with the *decision maker* and how he/she uses the system. The research program includes topics such as:

- Diagnostics for Business Process Performance.
- Development of Performance Measures.
- Modelling/ Simulation of Business Processes.
- Development and Testing of Scenarios.
- Metamodels and Aggregation of Diagnostics.
- Modelling and Predictions for System's Environment.
- Data Management and Software Tools.

(II) Open Communications and Software

The work here addresses the Software and Communication issues of the overall system. Central to this effort are issues of Standardisation and Software Integration. This aims to provide unrestricted flow of information, and in an appropriate form, to all business level activities using tools such as XML and future derivatives. Important parts in this effort are:

- Development of Standards.
- Cross sectoral generics and industry sector specifics.
- Product, Process and Production Data Modelling.
- Library of Open Source software.
- Software tools supporting modelling, diagnostics and decision making.
- Integration of software tools.

(III) Effective Flows and Portability of Knowledge

We now shift the emphasis on the system rather than the decision maker (area (I)) and we examine the system properties which may facilitate decision making. Central issues under investigation are what characterises the right information and type of knowledge for each of the decision making nodes within a Business and Operational organisation and how deviations from ideal patterns hinders

decision making and reduces effectiveness of decision process. The novelty in this area is the modelling of the global information system of the production and business environment using formal modelling tools, development of diagnostics and knowledge depositories, the specification of the control-management structures for the overall system and use of advanced methodologies for decision making. Within such a framework we include the modelling of the system's environment, and the effects of type of organisational structure on the decision making potential. Specific issues included are:

- Specification of the system and its environment.
- Development of information model for the system.
- Functional characterisation of system (colouring of nodes).
- Process Knowledge: characterisation, classification and representation.
- From data to information and to knowledge.
- Organisational structures and their evaluation.
- Repositories.

(III) Restructuring of Organisations and Resources

Systems, Processes and their information, management (control) structures have to change whenever it is realised that they are not suitable for the emerging requirements. Managing this change is always a tremendous task for which there is no systematic methodology, but heuristics and experience with similar processes/ systems. The development of a systemic approach based on formal methods for modelling, study of system dynamics, organisational structures, decision and information structures is a major challenge that is undertaken here and requires a qualitative step forward. This formal approach distinguishes the fundamental components of the overall system that may require change, complements the heuristics and it is the missing element in transforming Business Process enhancement from an art towards something that resembles of a engineering process. Amongst the issues to be considered are:

- Overall Indices and Benchmarking.
- Current Approaches and practices.
- Expectations, Future Business Requirements.
- Organisation and Flexibility.
- Formal Modelling Methods.
- Re-engineering the Information, Control Structures, Decision Policies and System Organisation.
- The Cost of Re-engineering.

(V) Control and Optimisation for Business Processes and Overall System

The area of control of Business Processes and the System as a whole using the powerful concepts, approaches, methods and tools developed for well defined engineering problem classes is challenging and novel. Such an effort goes hand in hand with the formal modelling of Business Processes and focuses on the

design, shaping of control structures and the development of Decision Making tools, including Optimisation, for delivering the appropriate strategy and implementation policy. Such developments have to consider the large scale nature of the problem, the requirements for flexibility and responsiveness and exploit the predictions on the changes in the system's environment. The development of such a framework and methodology for Business Processes requires significant leaps forward centered around the transformation of existing concepts and tools to the set up of business and involves research in areas such as:

- Large Scale Methods for Decision and Optimisation.
- Centralisation versus Decentralisation.
- Game Theory and Decision Making.
- Problem decomposition and sequencing in Decision Making.
- Diagnosability (Observability) and Implementability (Controllability) of policies
- Intelligent Methods for Decision Making.
- Supervisory strategies and Optimisation.
- Multi-Modelling, Hybrid and Multi-Time scale issues.
- Evaluation of Decision Making Strategies and Policies.
- Simulation of Decision Strategies and Policies.