Editorial

Xuan F. Zha*

Extension Systems International and
National Institute of Standards and Technology, USA
E-mail: xfzha@ieee.org
*Corresponding author

Weiming Shen

National Research Council Canada,
London, Ontario, Canada
E-mail: wshen@ieee.org

Biographical notes: Xuan F. Zha is the Co-founder and the Chief Scientist of Extension System International, USA. He is a Full Professor (Adjunct) of Shanghai JiaoTong University China. His current research interests include remote monitoring and intelligent service systems, ontology-based product and system lifecycle engineering, man-machine-environment system engineering, collaborative sustainable product development, knowledge management, artificial intelligence and soft computing in design and manufacturing, embedded and mechatronic systems, robotics and so forth. He has authored or co-authored over 140 papers, book chapters and reports in those areas. He is a Senior Member of IEEE and SME.

Weiming Shen received his BSc and MSc in Mechanical Engineering from Northern Jiaotong University, China in 1983 and 1986, and his PhD in Systems Control from the University of Technologies of Compiegne, France in 1996. He is currently a Senior Research Scientist at the National Research Council Canada's Centre for Computer-Assisted Construction Technologies. He has been working on intelligent software agents and their applications to collaborative engineering design and intelligent manufacturing since 1992. He has published two books and over 280 papers in scientific journals and international conferences, and co-edited five books and ten conference proceedings in the related areas.

Decision support systems (DSSs) are computer-based systems that support some or several phases of the individual, team, organisational or inter-organisational decision making process (Simon, 1997). DSSs may involve various technologies drawn from multiple disciplines, including information science, cognitive science, computer science, economics, engineering, business and management science and statistics, among others. DSSs can be categorised based on the complexity of the decision problem space and group composition. The combination of the dimensions of the problem space and group compositions in distributed collaborative environments in terms of time, spatial distribution and interaction results in a set of requirements that need to be addressed in different phases of the decision-making process (Gupta et al., 2006).

Collaborative design and manufacturing (CDM) (Shen et al, 2008; Sriram et al., 2006) essentially involves decision-making processes that require rigorous evaluation, comparison and selection of design and manufacturing solution alternatives and optimisation from a global perspective (Zha et al.,2008). Increasing design and manufacturing knowledge and supporting better collaborations among customers, engineers and partners to make intelligent, reliable decisions can result in higher quality products. Research on DSSs for collaborative design and manufacturing (CDM-DSSs) can be focused on both technical and organisational issues. From a technical perspective, advances in information technology, system engineering and artificial intelligence (AI) have improved the support capabilities for CDM-DSSs; in particular, AI and soft computing based technologies such as knowledge-based systems, neural networks, fuzzy logic, genetic algorithms, particle swarm optimisation, machine learning, Petri nets, intelligent software agents, hardware/software partitioning or co-design and intelligent user interfaces, have been recognised as significant enhancement tools for DSSs. Intelligent decision support systems (IDSSs) have now become more critical and are widely applied in collaborative decision-making processes, in which the decision support is exploited from the perspective of synthesis of collaborative decision-making process modelling, knowledge management and decision problem solving support (Zha et al.,2008).

This special issue aims at reporting relevant original efforts in the application of emerging DSSs techniques, in particular IDSSs, for CDM. The goal is to take a snapshot of the progress in the research into the decision support for CDM and to disseminate recent developments in IDSSs that can improve and enhance such support. The selected 12 papers provide an integrated and holistic perspective on this

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complex set of grand challenges and provide rigorous research findings and results. Specifically, these papers address various DSS/IDSS techniques developed with emerging decision models, methods and architecture and their applications in collaborative enterprise business and management, multidisciplinary collaborative design and optimisation and supply chain management. We briefly classified them into the following three groups.

The first group of four papers shows several emerging intelligent decision models and methods for multidisciplinary collaborative design and optimisation of complex engineering systems. Zheng and Liu present an improved particle swarm optimiser for collaborative optimisation to handle the difficulties such as increased computational time, slow convergence and unexpected non-linearity of compatibility constraints in traditional collaborative optimisation methods for multidisciplinary design of large scale complex engineering systems. Hu et al. present a robust decision and optimisation approach based on the multidisciplinary modelling for complex product development. The design knowledge is represented as a constraints network from multidisciplinary domain. The method was used to develop a knowledge driven multidisciplinary collaborative design system for railway vehicle development processes. Jagadeeswari and Bhuvaneswari present a novel multi-objective evolutionary algorithm for hardware/software co-design (partitioning) of embedded systems. A method is put forward for generating Pareto solutions by using elitist non-dominated sorting genetic algorithm (ENGA). The results of extensive hardware/software partitioning technique on numerous benchmarks are also presented, which can be used practically at the early stage of the design process. Yuan et al. propose a new collaborative control parameter design strategy for economic plant control process. The relevance vector machines (RVMs) and genetic algorithms (GAs) are applied to generate the optimal control index table. The probabilistic models based on RVM are identified to describe the non-linear behaviours according to the sampling experimental data; the evolution based optimisation is used to collaboratively design the optimum control parameter combinations. A variable-rate fertilising system is presented as a case study for control index table with combined accuracy, energy saving and fertilising consistency objectives.

The second group of four papers is related to the decision support service for network, configuration, coordination, optimisation and uncertainty management of collaborative enterprise business and supply chain management. Thimm and Rasmussen present an approach towards a decision support service for network moderators. The basic algorithmic design of an IT solution is described to act as decision support for the moderator of company networks. The focus is on the underlying scheme to compute a ranked list of alternative sets of orchestration for virtual organisations under consideration of selection criteria that may be flexibly chosen from a predefined set of criteria. Xu et al. develop a formalism based on coloured Petri nets for configuration of supply chain networks. System models are built upon the coloured Petri nets and used to incorporate product and process concerns into the supply chain configuration process. Kadadevaramath uses the particle swarm optimisation algorithm as the CDM and distribution optimisation tool to deal with the modelling and optimisation problem of a three-echelon supply chain network. The problem essentially involves decision-making processes that require rigorous evaluation, comparison and selection of design and manufacturing solution alternatives and optimisation from a global perspective. Shevshenko and Wang propose a robust decision support approach based on imprecise probabilities. Robust Bayesian belief networks with interval probabilities are used to estimate imprecise posterior probabilities in probabilistic inference. This generic approach is demonstrated with decision makings in design for closed-loop supply chains. The ultimate goal of robust intelligent DSSs is to enhance the effective use of information available in collaborative engineering environments.

The last group of four papers shows the framework for collaborative design decision-making, integration and application of distributed software agents and architecture, including dynamic trust modelling and access control in distributed collaborative computing or working environments. A new conceptual framework is reported by Bonjour et al. for modelling, managing and tracking knowledge-intensive, collaborative design decision-making processes. The proposed framework intends to help designers to support both technical and organisational decisions. Its originality comes from the concepts of ‘specific role’ and ‘action plan’ that enhance the recursive modelling of activities and are valuable at different detail levels of the decision-making processes: project, team and individual levels. Specific decision-making models and an industrial case study illustrate the relevance and usefulness of the proposed framework. Molloy et al. present a prototype tool for the assessment of decision-making systems (ToADS), to provide a decision support function through aiding configuration of decision-making systems (DMS) within an organisation. The prototype tool has been validated and applied in a series of industrial case studies. These studies are outlined, along with a summary of findings pertaining to both the tool development and wider implications for decision support. Pehlivan et al. adopt a new approach to exploring the fundamental differences between various distributed design architectures, with the goal of matching the requirements for an extendable CAFD environment capitalising on the strengths of various system architecture templates to support the requisites of fixture design information support. Li and Gui present the concepts, problems and research approaches of dynamic trust relationship and proposes an autonomic and dynamic trust decision-making mechanism, in which a direct trust computing method is based on the attenuation function and the feedback trust converging mechanism using direct trust tree (DTT) is set up. The proposed model uses two new operators to determine the classification weights of trust

decision factors automatically, which makes the proposed mechanism exhibit a more robust adaptability.

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