International Journal of Innovation and Technology Management

FROM THE SPECIAL ISSUE EDITORS: MULTI-AGENT SIMULATION AS A NOVEL DECISION SUPPORT TOOL FOR INNOVATION AND TECHNOLOGY MANAGEMENT

PEER-OLAF SIEBERS

School of Computer Science, The University of Nottingham, Jubilee Campus, Nottingham, Nottinghamshire, NG8 1BB, UK
peer-olaf.siebers@nottingham.ac.uk
http://www.cs.nott.ac.uk/~pos

IAN WILKINSON

Business School, The University of Sydney, Economics and Business Building, Sydney, New South Wales, 2006, Australia
i.wilkinson@econ.usyd.edu.au
http://sydney.edu.au/business/staff/ianw

Organizations and markets can both be seen as complex systems whose aggregate dynamics cannot often be inferred from their micro building blocks [Faggini and Lux (2008)]. Different traditional modeling methods exist to support researchers to understand and predict the behavior of such complex systems. However, most of these models are developed under the assumption of a state of stability, equilibrium and linearity, whereas real world organizations and markets are dynamic, non-linear and complex. Furthermore, such traditional models are usually input-output models and therefore do not give insight into the process of getting to a state of equilibrium.

Agent-Based Modeling and Simulation (ABM/S), with its intrinsic multidisciplinary approach, is gaining increasing attention as a problem-solving tool in the social sciences (particularly in economics, business, finance, and politics) [Wilkinson *et al.* (2003)] as well as in Operations Research [Siebers *et al.* (2010)]. It is a bottom-up modeling approach where aggregate dynamics emerge from the interactions of constituent components and between components and the environment [Gilbert and Terna (2000)]. It provides a powerful tool to study the dynamics of equilibrium and non-equilibrium systems over time and its outputs offer the potential to be used for explanatory, exploratory and predictive purposes [Twomey and Cadman (2000)].

The development of ABM/S technology has been rapid in recent years; however real world ABM/S applications found in innovation and technology management are rare (as indicated by the long time it took to put together this special issue). This is despite the recognition of the usefulness of simulation as a decision support tool for business analysts and managers [Garcia and Jager (2011)]. We believe that the transfer of knowledge, concepts, frameworks, and technologies between disciplines (i.e. between theoretical and applied sciences) represents the main barriers for ABM/S.

This special issue aims to fill the gap that exists in the literature for describing how newly developed formal approaches can be utilized by practitioners from different fields.

This helps bridge the gap between theoretical abstractions, where the focus is mainly on the decision making process to case based models, where the focus is mainly on representing the decisions made and to contribute to the research on empirical embeddedness [Boero and Squazzoni (2005)].

Unusual is that the special issue presents contributions from diverse research fields, amongst them Economics, Social Science, and Computer Science, which follow different schools of thought, and therefore have different and sometimes contradictory perspectives regarding what constitutes an agent or a multi-agent system. We have been open minded about this as we wanted to show what you can do with this novel approach and we hope that people will use the opportunity to learn from this special issue what is happening in surrounding fields. It was also quite difficult to find unbiased reviewers for such an interdisciplinary project as everyone tends to comment in favor of their own guild. Therefore we would particularly like to thank the numerous reviewers who have been very open minded and most of the time supportive and constructive.

Besides covering several research fields we have also a nice mix of contributions. We have academic contributions as well as contributions from industry. And while most papers report the success stories of using ABM/S we have also one paper where the application of ABM/S did not lead to success. The latter is often ignored in publications but we believe that publishing such experiences help to prevent others from making the same conceptual mistakes in the future.

The first paper by Wakolbinger *et al.* provides a comprehensive overview of the recent developments in the field of ABM with regards to market introduction and diffusion of new products. It focuses on reviewing papers that have recently been published in peer-reviewed journals and particularly discusses distinctive model features, namely the consideration of marketing activities, governmental policies, and various social influences such as word-of-mouth, specific social rules and network externalities. Based on the analysis of the literature it then outlines remaining research challenges and provides some directions for future research.

The purpose of the paper by Kortelainen and Lättilä is to analyze how a firm's agility effects to its competitiveness based on the logic of the resource based view. The analysis is done using a hybrid modeling approach to demonstrate the benefits of an agent-based modeling structure to support system dynamic modeling in strategic management research.

In the paper of Schütte an ABM/S approach is used to investigate the impacts of investment adjustments on product market competition. The model is validated with empirical data of the German pharmaceutical industry.

The paper by Henning and Saggau employs ABM/S to look at the process of knowledge spillovers and knowledge accumulation in interfirm networks. Simulation analyses result that global information network structures like local network size, clustering and centralization have a significant impact on the average rate of knowledge accumulation and hence realized technical progress in a network of firms. The impact of network structures, however, crucially depends on innovation intensity of firm's own R&D activities. If firms own R&D activities become extremely successful or unsuccessful, respectively, absorbing knowledge from other firms plays only a minor rule for the speed of firm's knowledge accumulation.

Shinde *et al*. create a framework for simulating and analyzing the effect of multiple business scenarios on the adoption behavior of a group of technology products, viewing diffusion as an emergent phenomena resulting from the interaction of consumers. In order to achieve this they use an ABM in which potential adopters of technology products are allowed to be influenced by their local interactions within the social network. The decision making of consumers is modeled using utility theory and discrete choice models. To demonstrate the ability of their framework they present a real world case study of a semiconductor chip manufacturer.

The paper by Rixen and Weigand focuses on a real world case study where ABM/S has been used to support decision making. The objective of their work is to simulate the diffusion of Smart Metering in Germany in different policy scenarios. The ABM has been used to forecast consumer purchase behavior and gain insights about adoption barriers and drivers. Results have contributed to the discussion, how Germany´s regulator Bundesnetzagentur can shape new regulatory frameworks in order to tackle adoption barriers and promote diffusion.

Barrot *et al.* present in their paper an outline of a model of personal communication influence on adoption behavior. Their objectives are to collect and analyze an empirical personal communication network data affecting an actual adoption process and to model different seeding strategies in order to optimize the speed of market penetration. When doing their experiments they uncovered the underlying network structure is the crucial element for diffusion or contagion processes. Whenever a network is too sparse or unconnected clusters too small, any intended viral or WOM marketing campaign will fail.

Pfeffer and Charley state in their paper that for simulating diffusion processes of opinions and beliefs in interpersonal communication networks one needs an adequate network model of real world interpersonal networks and a congruent diffusion model to describe the propagation of opinions and beliefs in these networks. For this purpose they introduce an algorithm to create stylized networks with attributes of real world interpersonal communication networks that can be used in network multi-agent simulations. They then demonstrate the importance of local clusters of connected agents for keeping opinions and beliefs endemic in a social system.

Finally, we would like to thank the editor of the journal, authors and reviewers for their patience as it has been a long process in the making. But we hope that you agree that in the end we have produced a very useful new reference of the current state-of-the-art in this field.

References

1. Boero, R. and Squazzoni, F. (2005). Does empirical embeddedness matter? Methodological issues on agent-based models for analytical science. *Journal of Artificial Societies and Social Simulation*, **8**, 4.
2. Faggini, M. and Lux, T. (2008). *Coping with the Complexity of Economics*, Springer, Milan.
3. Garcia, R. and Jager, W. (2011). From the special issue editors: Agent-based modeling of innovation diffusion. *Journal of Product Innovation Management*, **28**: 148-151.
4. Gilbert, N. and Terna, P. (2000). How to build and use agent-based models in Social Science. *Mind & Society*, **1**, 1: 57-72.
5. Siebers, P. O., Macal, C. M., Garnett, J., Buxton, D. and Pidd, M. (2010). Discrete-event simulation is dead, long live agent-based simulation. *Journal of Simulation*, **4**, 3: 204-210.

6. Twomey, P. and Cadman, R. (2002). Agent-based modeling of customer behavior in the telecoms and media markets. *Info - The Journal of Policy, Regulation and Strategy for Telecommunications*, **4**, 1: 56-63.
7. Wilkinson, I. and Young, L. (2003). A view from the edge. *Marketing Theory*, **3**, 1: 179-181.