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Editorial

Introduction: Modelling and simulation in futures studies

Futures research by its nature assumes a key role in analyzing and understanding the problems for a wide range of diverse areas and shaping the necessary policies for alternative futures through various methods. It can be suggested that futures research has emerged as a response to the needs of the society to minimize the uncertainty involved in looking ahead and to develop a rational set of behaviors in order to deal with this uncertainty. Modelling and simulation have been an important tools of futures research. The 1970s can be noted as a decade of global modelling studies. Social, political and economic problems dominated the topics of the corresponding works.

Futures Journal has published a number of papers that contain or refer to simulation models. The approach was popular in the 1980s with hopes for a 'global model', inspired not least by the modelling by the Club of Rome in the 1970s. Later, the focus has turned to integrated modelling and various forms based on model-centered science, (McKelvey, 1997, 1999) reflecting the development of complexity theory, computational power and modelling techniques. Some areas of futures studies, such as land use, population growth, economic activity and climate change rely heavily on simulation models to generate alternative futures.

Approaches to modelling and simulation are more extensively covered in the literature and practices of forecasting, than in Futures Studies, which is more exploratory, critical and learning-oriented as a mode of inquiry rather than explicitly predictive. This special issue seeks to contribute to the debate and help clarify the roles of modelling and simulation in many forms in the practices of Futures Studies and Futures Research, as it has been observed that simulation is likely to become an increasingly prominent method of theory development. (Eisenhardt & Bingham, 2007)

This special issue has been intended to analyze modelling and simulation from different perspectives. The journey has started with the search to come up with answers to the questions regarding

- Typical areas of use in futures field
- Appropriateness of the techniques for the diverse planet of problems in futures field
- Effective factors for the successful use of the techniques
- Evaluation of models
- Possible contributions to policy making
- Involvement of stakeholders
- Some application areas
- Exploring the future of the concept with the recent technological developments.

The special issue begins with the work of **Loveridge** in which he emphasizes the issues that are inherent in modelling and simulation, such as the problematic nature of it when it is expected to accurately explain and predict the real world phenomenon and fails to do so. But, at the same time, he acknowledges the importance of modelling and simulation in convergence of science, technology, engineering and society in this respect.

As Loveridge points out, the management of data and initial conditions of the model do matter for the accuracy, **Roth** brings problem of biases in selection of variables which impacts the quality of model in portraying the future to the table. This lack of perspective inevitably causes the modelers' failure to do comprehensive analysis on future oriented issues.

The human machine interaction such as quasi-game simulations and scenario visualizations provided due to the advancement computer technology defines new paths for the evolution futures studies. This has been discussed by **Zolfagharzadeh and Zackery** in this special issue. Human machine interaction is an important concept. The advancement of computational tools with their increased speed and efficiency has positive effects on operating and planning functions of businesses and on quality of life in general. As far as future studies are concerned, quantitative simulations enhanced by

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computers are claimed to have limited effect due to their simplicity and lack of creativity. Nevertheless, **Ahmadi et al.** propose that an approach based on computational cognitive agents may help to overcome this problem by making use of both qualitative and computational approaches.

As the previous discussion points out, modelling and simulation are evolutionary in terms of methodologies and tools. The progress clearly emphasizes the integration of stakeholders into the processes. **Aleksandra, Angel and Sheppard** argue that 3D interactive simulations using design inquiry as a development process, can be an effective way of communicating climate change solutions and multiple community responses. People are more likely to engage with the challenges associated with complexity of climate change at the local level when their perspectives are integrated into viable and multiple pathways for action. **Berg, Mineau and Rogers** review the scenario planning tool and put forth an alternative methodology for engaging expert stakeholders into the scenario generation process. They claim that a detailed questionnaire may systematize decision making process and create efficiency in time and cost and with more realistic and usable inputs.

Dynamic models are increasingly employed in a wide range of disciplines and system dynamics modelling is beneficial tool at this end. As cited earlier the advancement of computational technology has paved the way for the acknowledgement and use of these models. The article by **Chen, Yu and Wakeland** employs system dynamics simulation to generate an innovation diffusion model to operationalize the link between foresight and planning. They have used and analyzed possible expansion plans of 4 G wireless communication network of a Chinese service carrier as their case.

The modelling and simulation especially in global sense has its roots in the 1970s. The technology has enabled the area to come up with more sophisticated and complex products to explore the future in a different way and minimize the potential uncertainty and risk for humankind. Global forecasting systems dealing with global issues and problems of the society such as climate change, energy, education, poverty, carbon emissions, aging, sustainability and etc. entail those types of products for helping policy makers to generate the necessary plans, programs and regulations. **Hughes** discusses the international futures (IFS) system as a strong candidate in that sense with focus on the certain topics of human development, social development and the relations of human beings with their environment.

Hook and Barrios-O'Neill treat the energy problem in terms of sustainable management on the consumer's side and cleaner and more intelligent infrastructure on the producer's side using the potential of interactive gaming. They discuss the social, technological and narrative elements of game play as they can demonstrate complex system dynamics through simulation-based experiences with the data supplied in the real world. They also emphasize the potential of game simulation in revealing the complex patterns of interaction and cultural analysis around the energy use of public which may be regarded as important in policy generating process and can be exemplified for other areas.

Urbano and Gomez extend the system dynamics methodology to the business-related concepts such as entrepreneurship in Colombian context. New enterprises and especially small business are very central to the economic growth. Simulating scenarios from 2003 to 2032 their findings reveal the positive relation between innovative entrepreneurship rate and high economic growth. Although the limitations exist due to the selection and non-selection of the variables, still system dynamics allows the modelers to utilize complex models to simulate the real world.

Logistics is another area that this special issue has touched. **Halim, Kwakkel and Tavasszy** search for the necessary actions to overcome the intrinsic complexity and uncertainty of the global container transport network. Systematic exploration of the container flows based on scenario development process was their solution.

Derwisch et al. contributed to this special issue with their research on the role of expectations in the decision making process of farmers using survey data from Malawi. They employ dynamic simulation model to assess historical seed adoption patterns in Malawi and how counterfeit seed and branding affect farmers' expectation and adoption behavior. Testing the policies and assessing their importance on long term dynamics may be useful for other policy makers on their tasks.

Finally, **Li et al.** discuss the relation between online courses and global education as a public good. The online education opens new opportunities as well as threats to the society and especially on the traditional education system. They assert that it is also likely to give rise to the augmentation of human capital both for developed and developing countries. This paper tries to put forth how in this internet era the policy makers can manage the advantages and threats of this phenomenon on the education system and how they can sustain the continuous development with a coordinated effort between the countries.

We wish to thank all the authors for their contributions and the reviewers of this special section. We hope that the papers presented in this section will contribute to understanding the potential of Modelling and Simulation. We also hope to see researchers in the social sciences to embrace this phenomenon in their academic studies more in order to reserve its place in this interdisciplinary age of research.

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