Experiential Foresight: Participative Simulation Enables Social Reflexivity in a Complex World

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Abstract

Participative modelling and simulation activities have demonstrated that social innovation is achievable for present-day problems. Such activities enable our intentional exploration of future social configurations and their consequences and thus constitute a shared space for pre-experiencing and researching arrangements before they come into being. A form of "experiential foresight" involving combinations of social and non-social models is achieved by changing the roles and responsibilities of simulators/modellers and participants/customers in the simulation process supported by suitable technologies. Provides an alternative interpretation of often one-sided positivist perspectives of simulation theory and application, emphasising the emergence of reflexive social innovation in complex worlds.

Keywords: simulation and modelling, simulation games, agent-based simulation, simulation for learning, scenarios, action research, social synergy, symantic conception of theories

Introduction

Simulation is extensively used for studying physical and social phenomena and for the prediction of future conditions of such phenomena. If simulation is universally used for turning out technological innovations, is there in comparison a lower propensity to apply simulation for social innovation and prospective foresight? Does the traditional positivist mentality in the theory and practice of simulation hinder the application of simulation for social innovation? If the answer to both these questions is 'yes' as I propose in this essay then it becomes possible to examine the contribution that a reconsideration of simulation can provide to opening up our futures thinking to our experience of those futures.

Under the conventional simulation approach it is usually the simulation expert who is privileged to learn and acquire knowledge and who chooses, through their research theses, purposes for bringing about change. Contrary to this traditional practice of modelling and simulation, it is by means of the exchange of roles and responsibilities within the simulation process that provides the mechanism for the generation of a shared knowledge and action space for constructing and enacting future social scenarios. In addition, the shared action experience and reflection from that simulated situation brings into the participants' 'real' social life an experientially based reflexivity of things before those things come into existence.

In this essay I propose that the semantic conception of the realist philosophy of science is needed for an expansion of simulation to include participative simulation where models do not always comply with the strict positivist conception that forms the basis of simulation today. For applied foresight work this means the availability of another technique that fits within the existing prospective framework and also a technique that brings into one space action and discourse, experience and reflection. For social innovators this means an ability to combine the social and non-social aspects of the 'problem' domain and the ability to draw on the domain expertise and participation of the people into producing reflexive social outcomes. For the social groups in question this means the provision of a safe space in which social re-arrangements are tried, tested or developed before they are adopted.

This essay is concerned with bringing into the realms of traditional simulation the participative simulation, action research and action learning (AR/AL), and an alternative perspective on complex system simulation and its role in social innovation.

Participative Simulation for Social Innovation

Participative simulation has been used successfully in several studies resulting in social innovations or in decision-making regarding social re-arrangements. I shall use the term *participative simulation* to comprise any combination of the following situations:

- the group members participate in developing the system model to be used for experimentation,
- the system model is a tool in the group processes for accepting inputs and producing outputs that may then affect how the group processes proceed, or
- the group processes taking place represent an experimental instance of a simulation model of a modelled social situation,

wherein the group members include simulation experts, facilitators, and problem domain experts. Furthermore, the simulation models in use need not represent models of the specific problem domain under investigation. Following is a small selection of participative simulation examples used in social contexts and some of the major findings.

The systems dynamics community had recognised the value of the "modelling for learning" approach to building models prior to the 1990's (Morecroft & Sterman, 1994) and started the use of gaming simulators to allow controlled experiments with business managers in complex dynamic decision-making situations called learning laboratories (Langley & Morecroft, 2004).

Barreteau, Bousquet and Attonaty (2001) reported on their experiments with multi-agent and artificial life simulation systems and role playing games dealing with the collective management of the community's renewable resources. D'Aquino, Le Page, Bousquet and Bah (2003) used a participative approach wherein the stakeholders designed the role-playing game to accompany the decision-making processes of multipurpose land use management issues and sustainable development. The game sessions eventually led to the creation of a multi-agent model of land-use. Guyot and Honiden (2006) merged the role-playing game and the agent-based simulation into games where the participants controlled agents in the multi-agent simulation.

Lainema and Nurmi (2006) have taken the traditional business game even further by creating a dynamic computer-based business learning environment applied in a real-world business organisation.

Langley and Morecroft (2004) found that participants could improve their decision-making performance over successive games till a performance ceiling is reached. Barreteau, Bousquet and Attonaty (2001) report that players found ways to initiate negotiations about limited resources in their community. D'Aquino et al. (2003) found that the interaction between the participants led each participant to recognise the main causes of conflict in the situation and this resulted in novel and operationally successful agreements and proposals. Guyot and Honiden's (2006) findings concerned the difference between what participants would report as their behaviour and their actual behaviour during the game. The recorded actions and interactions allowed for faithful discussions of what happened. Lainema and Nurmi (2006) report that their business learning environment promoted dialogical interchange and reflexivity among the group members.

Participative simulations have also been used in foresight work in various formats and in combination with other futures methods. The number of studies is smaller and two examples are presented here.

Mayer, Carton, de Jong, Leijten, and Dammers (2004) used two long-term environmental scenarios of a particular urban network in two gaming sessions to explore and actually experience the future of development planning. The games provided a (re) enactment by a relatively large group of people of a part of reality in order to understand and manage that part of reality better than they were able to before. The results indicated a greater appreciation among participants of development planning and the future of the specific urban network.

The Decision Theatre planned for the Centre for Interactive Research on Sustainability (2007) is a participatory simulation for interactive decision making and learning purposes on a large scale that will produce experiences of alternative futures that will be tested with planners, politicians, and the public. The reactions and decisions of the participants will in turn be the subject of research for the laboratory.

The findings from these studies suggest that participative simulation experiences are relevant for a better understanding of how complex social-technological systems work and how to manage them. They could serve the purposes of training and education, allow for the observation of the behaviours of the participants, receive their feedback and thus facilitates research. This suggest parallels with the outcomes of participatory AR/AL namely education, sociological research and action.

Participative Simulation as Action Research / Action Learning

Simulation is an iterative process designed for particular purposes with two necessary phases:

- A modelling phase that is concerned with the conceptualisation, design and construction of models of real-world systems across chosen time and space domains.
- An experimentation phase that is concerned with realising and using those models (i.e. producing simulation models and experimental runs using those models).

The purposes for the simulation affect three major simulation design categories:

- model design choices that result in different information produced for the same real-world system,
- knowledge design choices that determine what is known or unknown in the model and the real-world system and therefore will affect the sequencing of parts and the direction of causation and knowledge inferences made, and
- role design choices that determine the functions and responsibilities of the participants and models in the simulation and will result in different arenas of transformation.

Participative simulations such as group simulation, simulation games, interactive simulation, user-centred simulation, and simulation for learning are produced by switching the traditional roles of expert modellers and simulators with the clients or the subjects of the 'problem' situation. The stakeholders of the situation may therefore develop a model from their own understanding of the situation during the modelling phase, may participate as agents in the simulation of the particular system or using the model during the experimental phase, or both. Together with the role choices there may be choices about additional models to represent the social interaction of the group required during the simulation process.

Through their participation the problem stakeholders will experience learning and transformation and therefore the design of such learning and transformation must be considered during the modelling phase. If role-playing game concepts are used to structure the simulation then experiential learning (Gentry, 1990) and adult learning principles (Knowles, Holton & Swanson, 2005) may be employed to involve not just cognitive learning but also affective and behavioural learning. Participative simulation borrows also from interactive social science, participatory methods and integrated assessment (Ramanath & Gilbert, 2004).

Participatory action research aims to produce education, sociological research and action by involving all relevant parties in actively examining current action in order to change and improve it (Wadsworth, 1998). Participative simulations are used for very similar purposes: training or education, research on and by the participants and of the simulation artefacts, and to support action and social innovation through individual and collective learning. Snabe and Grőßler (2006) investigated systems dynamics modelling for the implementation of organisational strategy and saw their case as a method of action research. Ruohomäki (2003) uses an action research intervention integrated with the use of a simulation game for organisational development with resultant organisational improvements.

In foresight work AL/AR is research by participants aimed at generating practical being and action for human betterment (Ramos, 2006) and anticipatory action learning combines AR/AL with futures studies as a process in which to question and explore the future (Inayatullah, 2002). With the three design categories of simulation it becomes possible to design participative simulations of future arrangements for which no current or past real-world system can be found. Yet no reports of participative simulation in foresight work that recognises AR/AL techniques could be found.

Comparing these participative simulations to the traditional approach to simulation shows that the overall effect could be to bring an evaluation of predictable consequences into the social reflexivity circuit.

Participative Simulation as Pre-experience Reflexivity Phenomenon

Reflexivity phenomena require that action take place to control processes before the estimated effects actually happen, not after (de Guzman, 1997). I shall define the word *pre-experience* to mean 'the activity of gaining knowledge or practical wisdom of future situations that one has observed, encountered, or undergone'. In a reflexive system, making choices for action depend on estimations of the effects of innovation expectations and participative simulations provides mechanisms for constructing, experiencing, and reflecting on proposed social innovations.

De Jouvenel (2000) defines prospective as an approach that helps us build the future, to create tomorrow's world. The scenarios tool is used because scenarios represent the dynamics of the system under study, the possible future paths taken by the system, and images of the results obtained from those paths. The paths are important and could be found working backward from the destination that could be achieved, or working forward to an image of what could happen.

Futures work has already demonstrated that scenarios can be used in participative simulations to pre-experience the future of development planning of an urban network (Mayer, et al. 2004). If the construction of scenarios is seen as the model construction phase of a simulation process, then the wider process in which this particular urban gaming experience was situated can be categorised as a participative simulation. According to the three simulation design categories then, models of non-existing systems can be created, the order in which knowledge is obtained can be reversed, and simulation can be also be used to facilitate participants to generate images of the future. Furthermore, a verbal or written description of a scenario provides the interested person with no sense of what it is to be actually involved in or what it personally takes to achieve such a scenario. As the urban game found, 'playing' the scenario provided an additional experiential reflexive element to the rational element of that particular social innovation.

If participative simulation can be used in prospective futures work, then it too becomes a valuable tool in a complex world that does not submit to prediction and forecasting. On what basis might that value be determined?

The Value of Experiential Foresight in a Complex World

Our recent and continuing tradition of a very successful and prodigious scientific enterprise has made us accustomed to an aesthetically pleasing and predictable world of stable equilibrium and linear behaviour. Even now we yearn to determine and direct the course of our futures. The scientific roots of simulation have also conditioned the futures world to a particular perspective of the value of simulation. For example, Bell (2003) groups simulation with computer modelling and separates it from the gaming exercise which typically involves a model, Inayatullah (2006) notices how simulation is a method used primarily in the predictive fields of futures studies and foresight to complete missing information in programmed knowledge, and de Jouvenel (2000) notes that models as sets of equations based on past observation are preferred by forecasters but rejected by futurists in favour of the scenario. A dizzying array of such traditional simulation models have been built and used for futures work of which a well-known example is found in *The Limits to Growth* (1972). Other similar simulations have followed like the International Futures simulation (Hughes & Johnson, 2005).

Linearity is the exception rather than the rule of this world and we often confuse the linearity of the scientific laws with the complex cause and effect relationships in social processes. Increasingly there are those who recognise the inadequacy of linear casual thinking, like Hjorth and Bagheri (2005) who argue that such thinking cannot provide us with effective solutions to the sustainability problems of modern society. The use of simulation in organisation theory dates back to work in the early 1960s but it is only since the 1990's that it become possible to use simulation to represent social phenomena using multi-agent models to represent the complex, dynamical societies (Gilbert, 2004). Gilbert discusses good examples and the value derived from their use.

As we become aware of a complex world we realise that each innovation only brings about greater complexity and further unexpected consequences. Greater reflexivity in respect to social innovations is called for, but with greater reflexivity and without different thinking, our systems will be quickly overwhelmed with uncertainty according to Leydesdorff and Franse (2007). As yet we have little capability to model what might happen under complex futures and are restricted to using complexity metaphors. Laszlo (2006) uses a complex system characteristic called "the butterfly effect" to describe the collapse of societies. A new and continuous social coordination mechanism for making decisions between sets of innovation options is needed and participative simulation provides such a mechanism considering the following reports:

- Lyons (2005) shows how the knowledge provided by complex systems models (used in a participatory simulation) pushes decision-making to levels where objectives and values dominate. Complexity arises not from the model itself but from the rich interactions between game players and events arising in the game. There are limits to the knowledge of the model; rather models should be seen as devices for negotiating meaning.
- Allen and Strathern (2005) demonstrate how knowledge is constantly created and destroyed in evolutionary market systems. The value of knowledge decays over time and what matters is the creation of new knowledge.

To show that participative simulation enables social innovation in a complex world requires showing that it produces additional synergy effects in society. Three synergy effects are chosen based on the list provided by Corning (2003):

- Augmentation or facilitation: Natural and social systems are combined into one simulation process to produce action and knowledge. This could lead to a blurring of the separation between the two worlds by modelling the interactions of entities from the two worlds. While not completely integrated, such processes are presently exemplified by agent-based group simulations incorporating natural resource simulation models (Guyot & Honiden, 2006).
- Threshold effects: Participative simulations could be designed to question the received future and to create multiple meanings of the future. This would potentially lead to an aggregation of doubts (or expectations) about a specific future amongst a larger group of people that could trigger a reaction in a more timely manner. This would serve as a social validation or rejection of some theory, before it is implemented.
- Joint environmental conditioning: The participative simulation combines the foresight research and the making of reflexive choices into one event. Participants research a futures image and at the same time 'experience' its effects. They can potentially make choices for change before those effects actually happen. It is not necessary that the simulation model generate predictions. It may be that the image is produced as part of the inquiry and the role of the simulation model is to assist the capacity of participants to produce outcomes.

These synergistic effects are suggestions that may contribute to research in social innovation, however a more expansive theory of simulation is required if participative simulation is to find an accepted place in foresight work.

A more expansive Theory of Simulation

The current foundations of conventional simulation theory are built on the logical empiricism (positivism) philosophy of science. This requires, for example, that the simulation model be verified for accuracy against the real-world system observation data within the particular experimental frame before it can be used with confidence. Thus, models of prospective social phenomena that cannot be verified, nor self-constructed models based on people's perceptions of reality are inadmissible to the simulation process. Positivism as a philosophy of science has been commonly rejected and the philosophy of science is coalescing around realism (Suppe, 1977). Twenty two years later Psillos (1999, p. xviii) finds that "scientific realism is still 'the best game in town'." Many variants of realism have been developed such as Azevedo's (1997) realist sociology and therefore it is suggested that realism is a first step to expanding the theory of simulation.

According to positivism the purposes of theories are to construct strict truth systems with laws about observable real-world phenomena. According to the semantic conception of theories under realism it is recognised that actual scientific practices of theory construction do not match the positivism assessment. For example theories are often conceptual devices employed for factual descriptions, idealisations, heuristic

accounts, and so on (Suppe, 1989). The point is that unverifiable or partly verified models can be used to test or construct prospective social arrangements. This would bring the theory of simulation in line with the practice of simulation and contribute to a different perception of models and simulation.

Conclusions

I have shown that participative simulations are being used for social innovation activities with positive results. In the futures field such activities are also accumulating positive results. I have proposed that by means of the role design category simulation provide the mechanism for the generation of a shared knowledge and action space for constructing and enacting future social scenarios. This proposal opens a new perspective on simulation as AR/AL and as reflexive social innovation to pre-experience future social re-arrangements and so deliver synergistic benefits in a complex world.

A search for participative simulation for social innovation reveals a much smaller base of activity compared to the use of simulation for technological innovation. In the futures and foresight fields the reports are even less in number and form an even tinier base compared to the use simulation for forecasting and prediction. To what extent the positivist mentality and the prodigious scientific endeavours based on simple and linear laws have contributed to this shortfall will remain to be tested. I have proposed that a first step towards righting the imbalance would be an expanded theory of simulation based on a realist philosophy.

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