Ulrich Frank and Klaus G. Troitzsch (2005)

Epistemological Perspectives on Simulation

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Abstract

This special section includes papers originally presented at a workshop on 'Epistemological Perspectives on Simulation' in July 2004 at the University of Koblenz, in which some thirty colleagues participated. It had been our impression that there was (and still is) a small, but growing number of researchers who are interested in investigating the preconditions of successfully deploying simulation as a research tool. We were convinced that discussing the epistemological status of simulation in a cross-disciplinary setting could contribute to a deeper understanding of relevant issues and so it proved.

Introduction

1.1

Simulation has been a research instrument for long in various disciplines. In recent years, it is gaining further attention. This may be contributed to the lack of theories that would allow for explaining and predicting the behaviour of complex systems. In addition to that, new modelling paradigms, associated with object-oriented concepts, intelligent agents, or models of (business) processes inspire the use of simulation. Also, the availability of computers with ever growing processing power makes it feasible to increase considerably the complexity of simulation models. Furthermore, it seems that simulation is regarded by some as an alternative to research methods that do not provide convincing support for certain research topics. At the same time, the epistemological status of simulation remains unclear. This is, for instance, the case for its relationship to core epistemological concepts, like truth and reason. Against this background, it seems worthwhile to reflect upon the preconditions of using simulation successfully as a research tool.

1.2

Two years ago, the simsoc mailing list experienced a longish discussion[1] among social scientists using simulation in their research. This discussion originated from Thomas Kron's question "about the relation of computer simulation and explanation, especially sociological

explanation". More than fifty contributions to this discussion followed within less than three weeks, and contributors discussed the role of simulation in theory building (mostly, but not only) in the social, economic and management sciences – as well as the relation between observation on one hand and computer-assisted theory building (Hanneman 1988) on the other. Scott Moss came back to his presidential address at the 1st conference of the European Social Simulation Association, Groningen, September 2003, in which he said "that if social simulation with agents is to be anything other than another in the long line of failed approaches to social science, it will be a positive departure only because it facilitates the dominance of observation over theory" and continued that the great successful scientists (outside the social sciences) built their generalisations around observation, developing new theoretical structures based on and validated by new evidence (quoted from his contribution to the simsoc mailing list as of November 14, 2003).

1.3

This discussion was one of the reasons for us to convene a workshop on "Epistemological Perspectives on Simulation" (EPOS) in July 2004, in which some thirty colleagues participated. It had been our impression that there was (and still is) a small, but growing number of researchers who are interested in investigating the preconditions of successfully deploying simulation as a research tool. While some of those have deployed simulation already in research projects, others are considering to use simulation. This is especially the case for those disciplines, where simulation plays a marginal role only, e.g. Business and Administration or Information Systems. While there is no established community so far especially in these disciplines, we were convinced that discussing the epistemological status of simulation in a cross-disciplinary setting could contribute to a deeper understanding of relevant issues. The issues which we wanted to be discussed were the following:

- What kind of research questions can be addressed by simulation?
- What are preconditions to be fulfilled for the proper use of simulation?
- What are lessons learnt from deploying simulation?
- How does a simulation model relate to reality?
- What kind of real world decisions can be supported by simulation?
- Are there any substantial advantages of particular paradigms, such as e. g. agent-based systems?
- What are prerequisites for simulating business processes?
- Is there a difference between approaches to simulation in different disciplines?
- What makes the quality of a simulation model?

Scientists from eight countries responded to the call for papers. A selection of the papers presented at the workshop is published in this special issue of JASSS.

1.4

In an inspiring and partially provocative article, Scott Moss and Bruce Edmonds argue that simulation provides the social sciences with a powerful instrument to generate empirical evidence – thereby contributing to better social sciences.

Jörg Becker, Björn Niehaves and Karsten Klose develop a framework for epistemological perspectives on simulation, which can be used to analyse and to systematise the implicit epistemological assumptions underlying most simulations. Their main concern is that these are often not made explicit and the framework they offer should help to explicate hidden assumptions.

Alex Schmid tries to answer the question "What is the truth of simulation?"For this purpose, he considers well known theories of truth to analyse how they could contribute to a concept of truth or appropriateness applicable to simulations.

Nuno David, Jaime Sichman and Helder Coelho analyse the methodological status of computer-based simulation in the social sciences. For this purpose, they introduce the term 'intentional

computing', which accounts for the specific epistemological characteristics of agent-based simulation.

Günter Küppers and Johannes Lenhard distinguish between the natural sciences and the social sciences mainly under the aspect that the former enjoy having well-accepted mathematical models while the latter have not. They argue that in the former case validation is no problem once it can be shown that a computer simulation model performs exactly the numerical calculations postulated by the mathematical model. As the social sciences have not yet developed generally accepted mathematical models, validation in this case means trying to find that "some of the characteristics of the social dynamics known from experience with the social world are reproduced by the simulation".

Matthias Meyer, Bernd O. Heine and Oliver Strangfeld analyse the special validation problems which arise from the fact that in most cases the system modelled in a simulation is only a stylised fact instead of a part of the real world. Thus in a way they tackle the same aspect as Günter Küppers and Johannes Lenhard as what they call "characteristics of the social dynamics known from experience with the social world" are often enough nothing but stylised facts.

Riccardo Boero and Flaminio Squazzoni suggest validating simulation through empirical research. They discuss and classify various validation strategies, and they argue for case-based models which lend themselves to falsification..

Finally, Petra Ahrweiler and Nigel Gilbert present a framework for evaluating the quality of simulations. For this purpose, they differentiate various views on a simulation. To illustrate their approach, they introduce the case study of a 'simulated' coffee shop.

1.5

The co-editors hope that these papers revive the discussion of the epistemological status of simulation which will perhaps never be finalised, and they are happy to be able to announce that the 1st EPOS workshop will have a successor, organised by Flaminio Squazzoni at the University of Brescia on October 4-5, 2006.

Notes

[1]The discussion can be found in the November 2003 section of http://www.jiscmail.ac.uk/archives/simsoc.html, topics "simulation and explanation" and "theory and simulation".

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