Alex Schmid (2005)

What is the Truth of Simulation?

Journal of Artificial Societies and Social Simulation vol. 8, no. 4
<http://jasss.soc.surrey.ac.uk/8/4/5.html>

For information about citing this article, click here

Received: 02-Oct-2005 Accepted: 02-Oct-2005 Published: 31-Oct-2005

Abstract

To understand the epistemological meaning of simulation, it does not suffice to interpret simulation practice and theory in the framework of philosophy of science alone. Theory, experiment, measurement and observation are important activities of the scientific method. But what regards an epistemological interpretation of simulation, philosophical truth theories allow gaining additional insights. This paper discusses philosophical truth theories — e.g. the correspondence, coherence and consensus theory — and relates them to simulation practice and methodology, focussing on validation.

Keywords:
Epistemology, Simulation, Truth Theories, Validation

Introduction

1.1

Simulation literature in philosophy of science and literature on validation never mention philosophical truth theories (e.g. Humphreys 2004; Sargent 2004), although validation is the "truth" topic in simulation. Why are established philosophical truth theories and their ultimate aim to understand the relation between the human mind, knowledge and reality, so much neglected in simulation theory?

1.2

Part of the answer might be the widespread sceptiscism what regards the role of philosophy towards science, especially towards natural science. What exactly is that relation between philosophy and science or especially simulation, a newly established scientific research practice? One of the most important goals of the philosophy of science is to clarify the epistemological status of scientific knowledge, according to the philosophical definition of knowledge as a *justified true belief* (Ladyman 2002). Justification, truth and belief are the three cornerstones of modern epistemology. In this paper I will concentrate on the notion of truth since every modeller would agree that simulations at least should have something that is applicable to reality, to the things "out there", and therefore they should obviously include some degree of "truth". If a simulation has nothing to do with truth, then it might be a video game, but does certainly not

deliver scientific knowledge. *Validation* is the specific procedure that is supposed to consider the "truthfulness" or applicability of a simulation model. But why should we consider philosophical "truth" instead of mere applicability or usefulness for a certain purpose that a client and a simulation expert may have in mind?

Truth and complexity

2.1

If simulations are known to capture complexity, making it more comprehensible, then — and this is my thesis — to just consider applicability for a certain system, or usefulness for a certain purpose does not do justice to the epistemological complexity of the simulation practice. What does applicability exactly mean? What kind of relation does applicability really establish between a model, a client and the target system? What *correspondence* of target system and model, what *consensus* of ideas, believes and common understandings shapes the usefulness of the simulation, and what *coherence* of scientific theories, axioms and deductions goes into the concept of applicability? It is obvious that with the application of the philosophical concept of truth we step one level deeper into the understanding of certain simulation assumptions and parts of the simulation process. I do not assume that this level of epistemological considerations should be a matter of everyday modelling and simulation. But if we want to understand the true epistemological complexity of simulation practice — the notion of "practice" itself points at the complexity of the simulation process — philosophical epistemology and the notion of truth in particular provide a sound basis to do so. If we stay in the framework of philosophy of science, of theory, experiment, hypothesis, observation and measurement we might not capture the underlying complexity.

Philosophical truth theories

3.1

First, there is the question if simulations are *truth worthy* at all. In philosophical terms, truth worthy is an object to which the concept of truth is applicable in principal, or in other words, of which it makes sense to speak of truth. Traditionally, linguistic objects like propositions or judgements are the main objects of truth. If one considers mathematics as a language capable of true statements and at the same time taking into account the communicative and linguistic nature of simulations in general, it should be obvious that simulations principally are truth worthy.

3.2

But once again, why should we apply truth to simulation instead of other more practical concepts like *adequacy*, *clearness* or *efficiency*? I would argue that all these views are present in the different philosophical truth perspectives and in addition, these perspectives offer a broader historical and scientific framework, deepening the epistemological discussion on simulation. Adequacy or applicability for example are concepts that can be more thoroughly discussed in the context of the multi-layered philosophical theory of truth than just as a concept in their own right.

3.3

The philosophy of science has developed a body of concepts like scientific realism, foundationalism, instrumentalism and falsificationism which all have a certain relation to the fundamental theories of philosophical truth. In fact, scientific realism includes some sort of correspondence theory of truth, supposing an objective connection or correspondence between our (simulation) statements and the existing things out there whereas instrumentalism links with some sort of coherence theory. But this layer of argument we will not taking into account if we think about the truth of simulation. We refer directly to the underlying fundamental philosophical theories. Unfortunately, there is not only one philosophical theory of truth but many. We can't expect therefore to find one relation or one solution for our question. Instead, we will find many useful truth criteria. Our guiding question can be stated as follows: *What are*

the truth theories or criteria from the philosophical tradition that offer a suitable theoretical and practical value in order to deal with the truth value of simulations?

3.4

From all the different philosophical truth theories we will only consider the *correspondence theory* of truth, the *consensus theory*, and the *coherence theory*. Obviously, these are not all philosophical theories, but from the point of view of simulation the most important ones. Every theory of truth offers another perspective on the philosophical "truth landscape" and it seems interesting to relate these perspectives to the different perspectives under which simulations are undertaken and applied.

3.5

The first theory, the *correspondence theory of truth* (see James 1907, Russell 1946) can be stated as follows: the criterion for a true proposition is the correspondence with a fact of reality. A simulation related version of the correspondence principle can be stated as: 1) *A simulation model is true if and only if it corresponds to a matter of fact in reality*.

3.6

Two fundamental questions follow from this priniciple: how is it possible to define this correspondence relation between statement and reality and what exactly means the concept of "reality"? Obviously, there is no final answer to these questions in philosophy, but there is an interesting aspect in relation to simulation which follows from the correspondence principle. The correspondence principle assumes that a simulation or mathematical proposition refers to one and only one matter of fact in reality. Hence, does this mean that a simulation model as an imitation of a system is one and only one proposition like "all men are mortal"? Does a simulation system suggest one proposition and only one or do the parts of the simulation model correspond to different parts of reality, the parts of the system? Or does the "system behaviour" consist of one proposition whereas the behaviour of parts or variables mean different propositions? But then what is the "truth relation" between these levels of propositional content? What does it mean if we consider the correspondence of processes? What specifically is it that a simulation corresponds to, and what "shape" of reality do we mean when we talk about this correspondence?

3.7

And what about *"imaginary"* simulations, simulations with parameter values not directly found in nature as in certain cosmological simulations? What exactly is the correspondence between a simulation model that relies on the fundamental constants of nature and another model that alters these constants in certain way to produce a different universe? Intuitively we know that there is a certain correspondence since the second simulation is a deviation of the first one. But it is another thing to define the "truth value" of the imaginary simulation since obviously it is not completely false, but how exactly does its deviation correspond to the "real" universe?

3.8

The correspondence principle of truth, the oldest truth theory which goes back to ancient Greece, which basically constitutes an "objective" *"reality perspective*", can be a mean to critically reflect all these relations. For example how *objective* is a simulation what regards its correspondence to a real system, and how *subjective* is the same model what regards its implicit assumptions, which we will refer to below in the consensus theory of truth? Other fundamental tensions between reality and models as complexity and simplicity, subtlety and concreteness or definiteness and indefiniteness (Pidd 2002) are additional factors that can be better understood, communicated and criticized taking into account the correspondence theory of truth.

3.9

The *consensus theory of truth* points in another direction and opens up a further perspective apart from the reality perspective. The simulation related version of the consensus theory can be stated as follows: 2) *A simulation model is true if and only if it is rationally acceptable under ideal or optimal conditions.*

3.10

This principle highlights at the same time the rational and social aspects of truth and constitutes basically a *"community perspective"*, present for example in Soft Systems Methodology (SSM) and in mental models in System Dynamics. The perspective of consensus entails a basically social and rational focus of truth (Habermas 1973). Simulations not only have an *"objective"* relation to reality but they exist in a *"subjective"* rational and communicative context. Of course, it is an open dispute about the objectivity or subjectivity of correspondence and consensus respectively, but the tendencies are clear.

3.11

Correspondence and consensus theories are different approaches and exhibit intermingling perspectives upon the "truth landscape" of simulations. Apart from the difficulties that the notion of ideal and optimal conditions is setting up in a philosophical context, the perspective of consensus theory offers a feasible approach to discuss the *communicative agreements* assessing the truth value of simulations. A simulation therefore relies fundamentally on the fact that its structure and its output are acceptable for rationally thinking people. How this process works in detail and the relative importance of this approach in relation to other perspectives, are questions that can be discussed based on the consensus theory of truth.

3.12

The third theory, the *coherence theory of truth* can be stated as follows: 3) *A simulation model is true if and only if it is a member of a coherent system of believes*. Following the coherence principle a simulation must be logically consistent and non-contradictory in a network of other believes (Blanshard 1939). If simulation results are not compatible with this system of believes, they can't be true. Intuitively, this truth approach which constitutes some kind of "*discourse perspective"* points to some difficulties. Particular strengths of simulations, as the discovery of emergent behaviour in complex systems or counterintuitive results, seem to be cases against this truth approach. Accordingly, there is no place for novelty in a coherent system of established believes. An additional philosophical criticism also states that there may be a coherent but nevertheless false systems of beliefs; it is not necessary in principle that a coherent system of beliefs must have a truth relationship to reality – it can be coherent and false at the same time. But the theory has its useful aspects in relation to the simulation effort since it states that — in contrast to the communication driven consensus theory — every simulation has its roots in a systematic discourse framework, might that be an economical, professional or historical discourse.

Validity, accuracy and truth

4.1

After we have explained the different epistemological truth theories, we will consider a "test case" for the application of philosophical truth theory, namely a part of the simulation process, *conceptual model validation*. The two key concepts in validation are *sufficient accuracy* and *specific purpose* (Robinson 2004).I will define these concepts in validation as follows: *"Validation is the process of determining the sufficient accuracy to which a model or simulation is a representation of the real world system from the perspective of the specific purpose of the model or simulation."*

4.2

Validity and accuracy have different decision values. While validity is a binary yes/no decision, accuracy is measured on a scale of zero to 100% (Robinson 2004). Robinson gives the example of a simulation model being absolutely inaccurate due to the lack of any empirical data, but it used to be still "valid" since it served the purpose of the simulation to show management that simulation in general would be one possible way to optimize the manufacturing process. Though the model lacked any sufficient accuracy, it was still valid from the perspective of its purpose. It follows that accuracy and validity don't need to match. A model can still be useful when its validity is given and its accuracy is poor.

4.3

Truth theories might help to understand the deeper epistemological meaning of these terms. Validity is closely related to purpose, and from an epistemological perspective purpose presupposes some more or less coherent structure of beliefs. If a certain purpose is not an irrational outbreak of arbitrariness, it is based on a chain of beliefs where an accomplished purpose is linked with a new state that in turn is the basis for a new purpose and so on.

4.4

What do we mean by saying a model is valid? In principal, we say nothing at all what regards the objective perspective of the correspondence theory that relates a model with reality. Validity refers primarily to the subjective part of a simulation, based on certain beliefs how a model should behave to meet the purpose. Back to our example: the coherent validity of the model for the manufacturer's management team may be absolutely wrong what regards its correspondence to reality, but the simulation reveals both truth of coherence and consensus because it satisfies the subjective purpose. Philosophically speaking, there is no solid ground for reasoning that a valid model is "less" true because it is not accurate. It is "accurate" and true from the point of view of consensus and coherence.

4.5

As modellers we are used to think in terms of correspondence or the accurateness of a simulation model to a target system which is a heritage of the scientific method in general. What we try to achieve is an accurate representation of the system in reality. We agree that sometimes a less accurate simulation model might be acceptable since it serves the customer needs. But we are not used to think that the inaccurate model has fundamentally the same truth value as the accurate model, albeit on different "truth levels".

4.6

The thought of *"the equal truth of the inaccurate"* is a challenging one for simulation practitioners, and that is exactly what the application of truth theories in simulation is aimed at: to challenge the epistemological bias of simulation practice and theory. Philosophical truth theories are neither right nor wrong, but they are different perspectives to discuss the problem in question. In addition, epistemology and truth theories highlight the importance and dynamics of non-mathematical human beliefs that are essential for science in general and simulation in particular.

References

BLANSHARD, Brand (1939) *The Nature of Thought*, London: Prometheus, 1964.

HABERMAS, Jürgen (1973) "Wahrheits-theorien", in: Helmut Fahrenbach (Hg.): *Wirklichkeit und Reflexion*. Pfullingen: Neske.

HUMPHREYS, Paul (2004) *Computational Science, Empiricism, and Scientific Method*, Oxford University Press

JAMES, William (1907) *Der Wahrheitsbegriff des Pragmatismus*. Frankfurt: Gunnar Skirbekk.

RUSSELL, Bertrand (1946) *William James*. Frankfurt: Gunnar Skirbekk, 1977.

LADYMAN, James (2002) *Understanding Philosophy of Science*, London: Routledge.

PIDD, Michael (2002) *Tools for thinking: Modelling in Management Science*. Wiley

ROBINSON, Stewart (2004) *Simulation — the practice of model development and use*. Wiley

SARGENT, Robert C. (2004) Validation and verification of simulation models, in *Proceedings of the 2004 Winter Simulation Conference* (eds. R.s Ingall and M.G. Rossetti). Washington, DC: SCS.

Return to Contents of this issue