Institute of Futurology
knowing our future

ProgBlog 10

2013

Outline of a scientific method for investigating the future

By Michael Lee

"Observation informs us about the past and the present; reason foretells the future."
Hans Riechenbach, *The Rise of Scientific Philosophy* (1951)

Nothing epistemologically exotic needs to be conjured up in order to develop a scientific method for studying the future. Futurology would simply hold itself accountable to customary disciplines of scientific thought.

The great scientific philosopher René Descartes stated: "A method is required in order to search for the truth about things."[1] The core word is method, based on the Greek *methodos* meaning pursuit of knowledge with *hodos* signifying "way". For our purposes, method means a systematic procedure for developing new knowledge.[2]

The importance of doing is this is that scientific knowledge can be useful to "human needs", leading to a mastery of nature, while also fostering human wisdom.[3] Knowledge, Descartes said, is desirable for "the discovery of an infinite number of devices that would enable us to enjoy, without any effort, the fruits of the earth and all the goods we find there, but, also, especially, for the preservation of health which is undoubtedly the foremost good and the foundation for all the other goods of this life."[4] As Hans Reichenbach, another respected scientific philosopher, pointed out: "knowledge is indispensable for the control of objects of our environment".[5]

[1] This was Rule Four of Descartes's twenty-one rules "for guiding one's intelligence in searching for the truth".
[2] "..a particular form of procedure for accomplishing or approaching something, especially a systematic or established one." Pearsall, J, ed. 1998. The New Oxford Dictionary of English. Oxford: Oxford University Press. 1164.
[3] Descartes, p. 117-118.
[4] Descartes, p.44.
[5] Reichenbach, P5.

The scientific method has unlimited potential for increasing understanding of the world: "…as long as one always observes the order required to deduce them from each other, there cannot be anything so remote that it cannot eventually be reached nor anything so hidden that it cannot eventually be uncovered."[6] The beauty of the method is its universality and flexibility, applicable to all kinds of subject matter.[7]

Descartes believed he'd discovered a method which was so powerful it had the potential to "arrive at a true knowledge of all things that [we] are capable of knowing."[8] For this father of modern philosophy, a method was a set of rules for distinguishing truth from falsity, outlining a sequence of steps which would lead to an increase of real knowledge. We're talking about a method of reasoning, made up of steps and rules, to produce systematic knowledge. This method is indispensable to scientific philosophy.

Integral to such a method is a series of steps which form the procedure it recommends. Thoughts and propositions are arranged in their proper sequence. For example, Descartes showed how effective reasoning can be when it follows a strict order from the simple to the more complex: "I decided that I would observe stubbornly an order in seeking knowledge of things so that, always beginning from the most simple and easy things, I would never proceed to others until it seemed that I could hope for nothing more from them."[9] He recommended beginning with the most simple propositions and gradually working up through induction and intuition to more complex truths: "In order to distinguish the simplest things from those that are complex and to search for them in an orderly way, one should notice what is most simple in each sequence of things in which we have directly deduced some truths from others, and how all the others are more, or less, or equally distant from the most simple item."[10]

As logic progresses, usually from simple to complex, the scientific philosopher builds new knowledge on either known truths or on propositions which cannot be easily disputed, which Descartes called self-evident first principles. Some knowledge is absolute in the sense that other secondary truths can be derived or deduced from them. Application of the method progresses along a "long chain of inferences" and follows a "continuous movement of thought".[11]

---

[6] Descartes, p.16.
[7] Descartes, p. 59. Letter to Mersenne, March 1637.
[8] Descartes, p.125 – rule four.
[9] Descartes, p.130.
[10] Descartes, p.131.
[11] Descartes, P.135.

Before applying this revolutionary scientific method to study of the future, it would be beneficial to conceptualize the general process for building a scientific theory, so elegantly described by Einstein: "Theories are evolved and are expressed…as statements of a large number of individual observations in the form of empirical laws, from which the general laws can be ascertained by comparison…but this point of view by no means embraces the whole of the actual process; for it slurs over the important part played by intuition and deductive thought in the development of an exact science… Guided by empirical data, the investigator…develops a system of thought, which, in general, is built up logically from a small number of fundamental assumptions, the so-called axioms. We call such a system of thought a *theory*. The theory finds justification for its existence in the fact that it correlates a large number of single observations, and it is just here that the 'truth' of the theory lies."[12]

This is a lengthy quote but when it comes to science few say it better than Einstein. If futurology is to evolve into a science its method would follow the steps outlined in this passage, namely:

- an inductive process consisting of a number of accurate observations which have been consolidated, or generalized, into empirical laws or statements of underlying relationships between key variables.
- a deductive, intuitive process by which the scientific "investigator" places his observations into a larger system of thought, or theory[13] based on fundamental axioms.

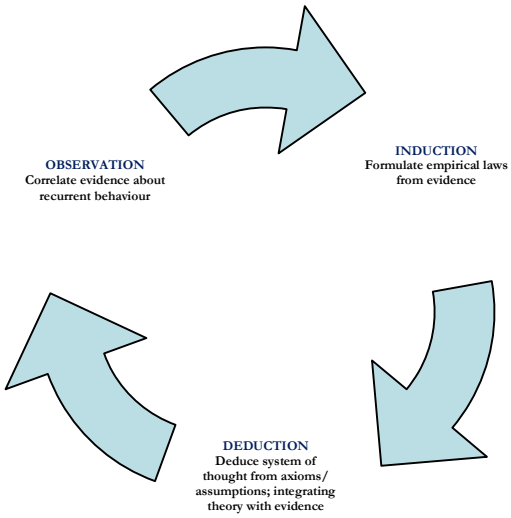

Figure 1: Einstein's model for developing scientific theories

[12] Einstein *Relativity* (1916) 139-140.
[13] Hawking & Mlodinow *The Grand Design* (2010) 32. An effective theory in physics is "a framework created to model certain observed phenomena without describing in detail all the underlying processes."

Induction and deduction are systematic ways of reasoning within a framework of recognized axioms. These axioms are theoretical principles established beyond reasonable doubt in the body of scientific knowledge, for example, laws of causation or the theories of relativity and evolution. One of the messages of Figure 1 is that the combination of inductive and deductive reasoning is self-reinforcing, setting up a virtuous cycle of knowledge accumulation and verification. The scientific investigator then tests the consistency of his conclusions against the principles of established models of the physical world.

Of special relevance to the futurist is the way causation works in producing effects in the future. Descartes described perfect science as "knowledge of effects through causes".[14] Reichenbach described causation in these words: "by a causal law the scientist understands a relation of the form *if-then*, with the addition that the same relation holds at all times… The addition in terms of *always* distinguishes the causal law from a chance coincidence...*if-then always* is all that is meant by a causal relation..."[15] The idea here is that causation has been accepted by science as a universal force. It's a framework which describes an unlimited number of relationships between variables influencing one another in the world in patterns of behaviour which are recurrent, applicable in different conditions.

In Figure 1, then, a series of observations is inferred to exhibit some form of universal or general relationship which the scientific investigator then takes to the next level by testing whether that inferred relationship is consistent within current scientific knowledge.

The scientific method which is the subject of this paper is probably the essence of modern thought. Its positive impact on changing the world for the better is so profound it would be virtually immeasurable. Imagine, if you dare, the potential for applying it to study of the future?

Descartes broke new ground in understanding how to be methodical in reasoning. He was one of the world's first inter-disciplinary generalists. His principles and conclusions, such as his brilliant deduction "I think, therefore I am", have echoed across the centuries. Let's explore further the mental processes involved in gaining new knowledge to provide a wider context for understanding the scientific method.

[14] Descartes, Principles – p.121.
[15] Reichenbach, H.1951. *The Rise of Scientific Philosophy*. Berkeley: University of California Press. 157-8.

In Figure 1, Einstein indicated that induction needs to be continuously supported by deduction. The investigator attempts to connect his conclusions about the underlying regularities of the particular phenomenon he has been observing to a wider theory about how the world works. As mentioned, he will check to see if his new findings are consistent within governing worldviews of science.

In "Regularity and predictability: piecing together the 'unseen unknown' of the future", induction and deduction were explained. With induction, a series of observations leads to a reasonable conclusion about a pattern of regular behaviour, perhaps as part of a causal order. The logical movement in induction is from observing something known and to understanding something unknown about underlying relationships guiding the way variables influence one another. In his Rule Twelve, Descartes narrowed down scientific investigation to three factors: "first, that which is evident in itself; then how one thing can be known from something else; and what can be concluded from both of them."[16]

Reichenbach (1951:80) argued that reason and sense observation together drive science forward. Reason identifies "abstract relations of order" underlying observed phenomena: "If the abstract relations are general truths, they hold not only for the observations made, but also for the observations not yet made; they include not only an account of past experiences, but also predictions of future experiences. That is the addition which reason makes to knowledge."[17]

This isn't rocket science. It's daily life. Our knowledge of the world beings and ends with observation. We continuously support our observations by reasoning about the relations between things all around us. We are eternally curious about how the world holds together and what causes everything that happens around us. There's always a difference between observed facts and these deeper analytical truths deduced by reason.

Descartes agrees with Einstein about combining induction and deduction: "…the only way to acquire scientific knowledge is by intuition and deduction".[18] The French philosopher saw intuition and deduction as the two most powerful operations of the intellect or reason. In his Rule Eleven, he added a third operation called enumeration, which is better known as induction, described as "inference from many and disparate things".[19]

We see there are three main mental processes used by the modern scientist – induction, deduction and intuition.

[16] Descartes, P.151.
[17] Reichenbach, p.80.
[18] Descartes, p.126.
[19] Descartes, p.149.

Later, in Rule Twelve, Descartes adds a fourth, of vital importance to futurists, namely, memory: "We have only four faculties in us that we can use [for knowledge]...namely, the intellect, imagination, sensation and memory. The intellect alone is capable of perceiving the truth, but it must be assisted by the imagination, sensation and memory, so that we do not happen to omit anything that was provided by our powers."[20]

These are the four mental powers on which the futurist can draw. He has reason to make deductions, imagination to visualize holistic connections between relevant facts, ideas and theories, sensation for observations of physical realities on which induction is based and, finally, memory to look into proven historical time patterns.

The flow of systematic reasoning pictured in Figure 1 controls the way meaning and knowledge are produced during scientific thought. Riechenbach explains: "Instead of unknowable things, the empiricist speaks of unobservable things; but such things are accessible to knowledge…Statements about unobservable things have meaning inasmuch as they are derived from observation; they acquire meaning by transfer, that is, by their reaction to observable things".[21] While induction transfers meaning from the observed to the unobserved, deduction ensures internal cohesion by testing the conclusions about relationships behind the observed regular behaviour against widely accepted scientific theory. Likewise, the discipline of futurology would be based on scientific logic where meaning is carefully controlled to keep it consistent.

Meaning to be consistent hinges on verifiability, either through observation or through inference from the known: "to go beyond the observables by means of scientific inference is the legitimate method of the empiricist."[22] For Reichenbach, the main difference between speculative philosophy and scientific philosophy is that with the former, knowledge is not dependent upon observational evidence. What excites me is that prediction is an integral part of scientific philosophy which is one reason why this approach seems tailor-made for futurists: "Scientific philosophy…regards knowledge as an instrument of prediction and for which sense observation is the only admissible criterion of…truth."[23] Reichenbach claimed his ultimate goal was the "foretelling of the rolling of the dice of the cosmos"[24] so as to control and shape the future.[25]

---

[20] Descartes, p.151.
[21] Reichenbach, p.259.
[22] Reichenbach, p.254, 256.
[23] Reichenbach, P.252.
[24] Reichenbach, P.249.
[25] Reichenbach, P.246: "To control the future – to shape future happenings according to a plan – presupposes predictive knowledge of what will happen if certain conditions are realized…the justification of induction is that it is the best instrument of action known to us…"

For example, a futurist may be making assessments of the future of the global economy. He would build up forecasts based on current and past economic data. This is inductive analysis. Then he could contextualize these forecasts within a broader theory of the Kondratieff long waves and Schumpeter's theory of business cycles within economic evolution. He would look at the main production cycles for global energy. He would look at patterns of supply and demand. This is deductive reasoning, by which the future analysis is fitted into recognized time-patterns from history. Induction and deduction reinforce each other in a virtuous cycle seen in Figure 1. This ensures the analysis is theoretically robust as well as sound in its detailed empirical observations.

Such a process represents the power of science to produce logically cogent knowledge.

Having assessed the processes of a scientific method, we may move to the kind of knowledge produced by the method, especially as applied to the future. It's important to state that most predictive scientific knowledge is probable rather than absolutely certain: "the theory of probability supplies the instrument of predictive knowledge as well as the form of the laws of nature; its subject is the very nerve of scientific method."[26]

Just as detectives try to find the most probable explanation by eliminating the least likely scenarios, so the futurist tries to narrow down the most probable future outcomes based on intensive analysis.

Predictive knowledge is largely probable knowledge but the question is: how probable? According to Reichenbach, probability is based on "frequency interpretation" and is "the limit of a frequency": "Probability statements express relative frequencies of repeated events, that is, frequencies counted as a percentage of the total. They are derived from frequencies observed in the past and include the assumption that the same frequencies will hold approximately for the future. They are constructed by means of the inductive inference. If we regard the probability of heads for the tossing of a coin as being given by one-half, we mean that in repeated throws of the coin heads will turn up in 50 percent of the cases."[27] We are all familiar with fifty-fifty situations and understand what it means when we're told there's a 75 per cent chance of something happening. Probabilities are determined by aggregating repeated events and estimating the likelihood of their recurrence. The more regular the behaviour being studied, the closer we can push probability towards certainty (which, by definition, is 100% probability).

[26] Reichenbach p.233.
[27] Reichenbach, p.236, 246.

The concept of something being regular is temporal in nature, rather than spatial. It's about repeated behaviour which is periodic. Cycles in nature and society are examples. Einstein showed definitively that time is a dimension we should always measure simply because space and time are indivisible in the continuum of physical existence. Dimensions have coordinates and are measurable. Descartes defined a dimension as "merely the mode or respect in which something is considered to be measurable. Thus length, breadth and depth are not only dimensions of a body, but weight is also a dimension according to which objects are weighed, and speed a dimension of motion…." (Descartes 1637:176) For the 4D world Einstein unveiled in this special theory of relativity, which has 3 spatial coordinates and 1 time coordinate, we need to locate everything in one place at one time and follow its evolution through space-time.

For futurological knowledge, it's necessary to evolutionize the material being studied, that is, to place it within its time trajectory, measuring long-term change, growth, progress, decline, etc. A science of the future would not just deductively test the theoretical consistency of its inductive conclusions, which originated, as we know, in a series of observations of behaviour in the spatial world, but would also evaluate those conclusions through evolutionization in time. This means adding time-based analysis, for example, identifying time patterns or cycles.

There is a further step to this proposed method: to contextualize the behaviour within a network of interdependent systems in nature and society. The social world we observe exists on top of the physical world in a stack of interconnected realities within 4D space-time. Space and time are intertwined. And they are a moving target. Nature and society are intertwined. This is a deeply networked world we study.

Therefore, futurology has to be interdisciplinary in the way Descartes suggested science should be for maximum impact. The futurist looks for extensive, interlocking, enmeshing interconnections between systems. His analysis must increase the number and the interconnectedness of observed social facts into a network of holistic inferences which are tied into a scientific theory of the physical world.

In my 2012 study of the future of North Korea, I collected past and present facts about the country. This was induction. I also analysed evolutionary time patterns on the Korean peninsula. To contextualize my observations, I placed the nation within the dynamics of its region, in the neighbourhood of Japan, China and Russia. I tried to make inferences about all the facts. I tried to interconnect the facts with deductive reasoning. The more richly interconnected the facts, the more networked and holistic they become within the total evolution of space-time. In short, I evolutionized and contextualized the facts, using analysis and intuition. A holistic, networked picture of the future, consistent with space-time evolution, finally emerged.

It seems to be a principle of social sciences that the more interconnected knowledge is, rooted in systems, the higher its value as a predictive tool.

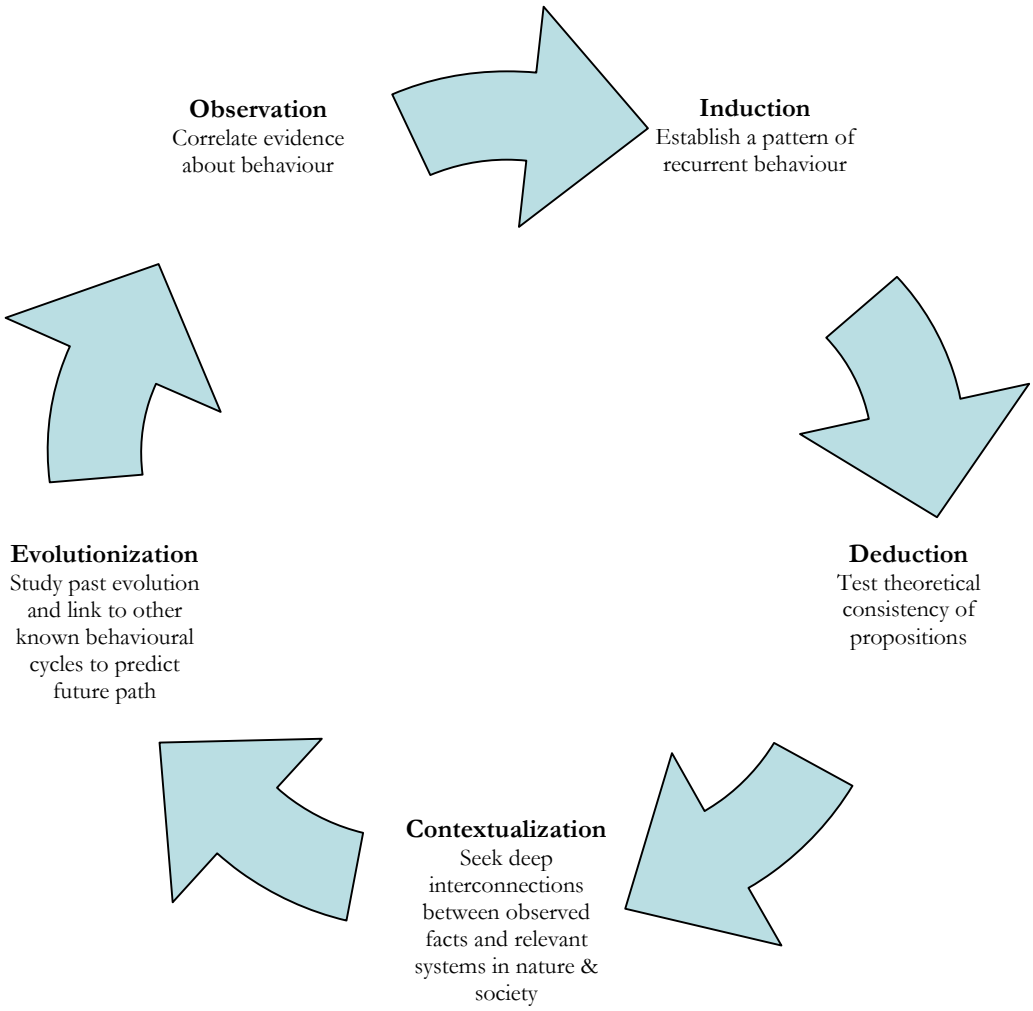

Figure 2: Scientific model for study of the future

© Institute of Futurology

Evolutionization and systematic contextualization enable the futurist to heighten the probability of his statements about the future. We take probabilistic statements about the future and contextualize them in a holistic, interdependent world of networked systems to nudge the probabilities ineluctably towards certainty. Yet, we aren't looking for absolute truth of the future. Rather, we're producing highly probable truth framed by a network of interconnected facts.

Conclusion

This method of futuring is a battle-plan to confront understanding of tomorrow's evolving world. Now it's time to invade the future.

Acknowledgments

Descartes, R. (1637). 1999. *Discourse on Method for Guiding Reason and Searching for Truth in the Sciences and Related Writings*. London: Penguin Books.

Descartes, R. (1641).1998. *Meditations and Other Metaphysical Writings*. London: Penguin Books.

Einstein, A. 1916. *Relativity*. St Petersburg, Florida: Red and Black Publishers.

Hawking, S. & Mlodinow, L. 2010. *The Grand Design*. London: Bantam Press.

Pearsall, J, ed. 1998. *The New Oxford Dictionary of English*. Oxford: Oxford University Press.

Reichenbach, H.1951. *The Rise of Scientific Philosophy*. Berkeley: University of California Press.