Foresight in an Unpredictable World

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Unpredictability has two main sources: epistemic uncertainty and ontological unpredictability. When disruptive and downstream innovation become frequent, ontological unpredictability becomes increasingly important for innovation policy and strategy. The analysis of the nature of ontological unpredictability explains why future-oriented technology analysis and foresight frequently fail to grasp socially and economically important technical developments, and clarifies the reasons why policy, strategy and future-oriented analysis need to move beyond evidence-based approaches.

Keywords: unpredictability; ontological expansion; anticipatory systems; innovation; creative evolution

Introduction

Predictions about future almost always fail. In this paper, the epistemic and ontological causes for this failure are described and their implications for foresight, innovation policy and strategy are explored. The paper introduces the idea of "ontological unpredictability" and shows how innovation leads to unpredictability that cannot be removed by more accurate data or incremental improvements in existing predictive models. Based on the presented analysis, it highlights some methodological implications for future-oriented analysis and policy-making.

The paper aims at a conceptual contribution that builds on several disciplines, ranging from innovation and technology studies to a Bergsonian analysis of creative evolution, theory of autopoietic and anticipatory systems, and cultural-historical theories of cognitive development and social learning.

The paper is organised as follows. The next section introduces the two sources of unpredictability: epistemic uncertainty and ontological unpredictability. The following section then further elaborates the idea of ontological unpredictability in the context of innovation theory, showing that downstream innovation leads to a practically important form of ontological unpredictability. It then introduces Bergson's model of creative evolution, showing that it leads to ontological expansion, and illustrates this using the expansion of mobile phone industry as an example.

The paper then makes the claim that technological change can be understood as an especially human form of Bergsonian élan vital or creative flux. In contrast to Darwinian models of evolution where selection weeds out unsustainable developments, in the Bergsonian model living processes are active generators of novelty, and evolution is an essentially open-ended and non-optimizing process. We use a simple illustration of a mountaineer to illustrate such an open-ended process of path-finding, and use some ideas from cultural-historical theory to argue that modelling the directionality of the innovative élan requires analysis of progress at several time-scales.

The paper then moves to a more detailed analysis of the phenomenon of ontological unpredictability. For this we describe and expand Robert Rosen's analysis of the nature of modelling and the relationships between natural and formal systems.

Based on these conceptual developments, the paper then proposes some practical implications for future-oriented research and policy. The analysis in this paper essentially says that innovation and predictive models are theoretically incompatible. Policy relevant future-oriented analysis, therefore, needs to emphasize processes that support insight, intuition and innovation, instead of relying on data collected using historically important categories and measurement instruments. Economic and social trends measure what used to be important and often miss things that will be important.

To understand how innovation generates progress, we have to reconsider some key concepts that underlie future-oriented analysis and strategic management.

Two Sources of Unpredictability

In much of contemporary thinking, failures in prediction indicate a need to engage in further study and research. If we only had accurate data and models, we could have good predictions. In this view, our data and models are only approximations, and epistemic progress can occur through incremental improvement. Although there may be cognitive and economic limitations, in this view, the levels of certainty and rationality could be increased by better evidence and knowledge, and progress can be measured against an ideal of perfect knowledge.

At least since the 1970s, it has been well understood that even when the world unfolds in a completely deterministic fashion under well-known natural laws, its complexity makes it impossible to perfectly know its future. Already relatively simple systems have interactions, non-linear dynamics, and sensitivity that lead to chaos, strange attractors, and catastrophes that make a good prediction hard to find (Lorenz 1963; Ruelle and Takens 1971; Feigenbaum 1978; Thom 1972; Nicolis and Prigogine 1977; Haken 1981). For all that we know physical nature can be indeterminate.

Social scientists (e.g. Goffman 1959; Giddens 1984; Beck, Giddens, and Lash 1994; Luhmann 1990) have further emphasized the point that reflexivity in thought and action creates a delicate balance between predictability and unpredictability in social systems and interactions. As soon as we have an explicit theory of human or social behaviour, it influences the way in which we think and live, thus, in general, making the theory obsolete and prediction futile.

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Implications for strategy and policy-making

When true uncertainty and ontological expansion are important, formal models rarely provide useful predictions. Innovation expands the ontological space, making previously invisible aspects of the world visible and relevant for modelling. In such a situation, formal models cannot be made more accurate by collecting more data or measuring the observables more accurately. Innovation changes the way in which the natural system itself needs to be constructed. Ontological expansion means that we do not need a better model; instead, we need a different model.

This creates a challenge for formal modelling. In practice, many future-oriented models are based on time-series data. Such data can be collected only if the ontology, its encodings and the measurement instruments that generate the data remain stable. In general, the data required for formal models are available only in domains where innovation has not been important, and it will have predictive value only if innovation remains unimportant. For example, data on phone calls or callers could not have been used to predict industry developments when short messaging became the dominant source of growth in the industry. Similarly, historical data on national accounts can tell very little about future economic developments, as the data are collected on categories that used to be important in the industrial economies and value production models of the 20th century. Although many researchers believe that methodologically sound research requires that they stick to well-known and frequently used historical data sets, this approach cannot lead to methodologically robust predictions.

Similarly, reactive what-if models can only provide predictive value if innovation is unimportant. Specifically, there is little reason to believe that conventional "impact analysis" models could lead to useful insights if innovation matters.

In general, facts exist only for natural systems that have associated measurement instruments and established encodings and decodings between the natural system and its formal model. Facts rarely exist for ontologically new phenomena. It is therefore very difficult to formally model systems when innovation matters. Policies that are legitimized by facts, therefore, are methodologically problematic. Although evidence-based policy-making may be practically useful in the sense that it generates a common frame for policy debates, it may be harmful because it inherently neglects innovation and knowledge creation.

When innovation is important, foresight efforts therefore could more appropriately be located around the problem of articulating natural systems, instead of formulating predictive models. In other words, the focus of future-oriented analysis should be learning, problem redefinition and innovative construction of new empirically relevant categories, not predictive modelling.

An example here is the problem of formulating "grand societal challenges." Typically, such societal challenges are based on extrapolations of historical trends, and thus implicitly assume that historically relevant categories remain important also in the future. For example, ageing may become a "grand challenge" when we assume an industrial age model of factory-based production, industrial era life-patterns and health-services, an educational system geared towards producing skilled labour, and public financing systems that are based on all the above assumptions. In other words, assuming that the industrial society remains as it used to be, extrapolations from demographic data lead to an unsustainable state. These assumptions, however, are difficult to maintain if we also assume that these societies are transforming towards knowledge societies where innovation is an important economic factor. Simply looking at the demographic predictions, elderly people could well become the dominant productive force in the next decades, instead of a grand challenge.

If the future can not be predicted before it happens, foresight requires an imaginative step that resembles the movement of a mountain climber towards the next hold. For purely ontological reasons, foresight cannot be based on reactive models. Models inspired by physics, control theory or economics are structurally unable to encompass ontological expansion and innovation. They should therefore be used with caution. Foresight efforts can probably best be organized using reflective learning and knowledge creation as their theoretical framework. If innovation is important, we probably should give relatively little weight for trend extrapolations, what-if analyses, and time-series data, and instead facilitate creativity and embrace innovation.

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