

Book reviews

From conceptual modeling to quantitative measure

Benedetto Lepori

***The Knowledge-Based-Economy: Modeled, Measured, Simulated* by Loet Leydesdorff**

Universal Publishers, Florida, 2006, 385 pages, €16.95, ISBN 1-58112-937-8

The notion of knowledge-based economy has been introduced in recent years in the economics of science and innovation, to indicate a qualitative transition in economic conditions where knowledge production has become central for the economic dynamics and development. As such, it has also been widely used in political discussion especially at the European level.

However, already some of its fathers have remarked that, if this concept is not to become a sort of buzzword without a precise meaning, both a sound conceptualization of what is meant by it and a set of tools to measure this phenomenon empirically are required. On both requirements, Loet Leydesdorff, professor at the Amsterdam School of Communications Research, has provided outstanding contributions during its whole scientific career.

First of all, he has developed in the last two decades a strong theoretical view of the knowledge-based economy, based on Luhmann systems theory and on the centrality of communication for the co-evolution of knowledge systems, economic markets and political systems. Second, he successfully proved that, exactly based on this conceptual modeling, it is possible to design quantitative measures of some aspects of the knowledge economy and has thus provided a number of original contributions to quantitative science and technology studies, for

example, in the analysis of scientific fields and networks using bibliometric indicators and in the measurement of the dynamics of the knowledge economy and of triple helix interaction.

This new book covers these two dimensions of Loet's work. Thus, the reader is firstly given an introduction to the concept of knowledge-based economy and its implications to the dynamics of social systems. Leydesdorff argues that the emergence of knowledge production and control as a third coordination mechanism to the social system alongside economic exchange and political control leads to a profoundly different dynamics from in market-based systems.

Further, Leydesdorff identifies the specificity of knowledge in its ability to codify meanings and thus to reduce uncertainty in the (collective) representation of the social system by becoming increasingly selective as to the information to be retained as relevant; across time, this provides a capacity to produce informed expectations of possible futures, which are then fed back into historical processes. It is exactly this reflective and anticipatory capacity that accounts for the stability of the evolutionary trajectory of the knowledge-based economy, leading to self-organizing patterns like that observed in the triple helix. These arguments are discussed in detail in the second chapter, where the author provides a more complete discussion based on the Luhmann sociological theory of communication.

Among the most fascinating aspects of this analysis is the use of mathematical simulations to display the specific features of so-called anticipatory systems, that is, systems that, by containing a representation of themselves, are able to predict their future state and, to some extent, to reconstruct it. Leydesdorff thus brings Luhmann's theory a step further, going from general theorizing to modeling and operationalization.

The next series of chapters deepen the analysis of the anticipatory character of social systems and situate

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it in the context of functional differentiation of society; thus, the anticipation is profoundly modified in a functionally differentiated system such as modern society, since subsystems are not synchronized and meaning is differently codified in each of them. Accordingly, the system cannot be any more organized hierarchically, but becomes self-organizing.

The centrality of communication in this process explains why the diffusion of new means of communication, such as the printing press in the 15th century, has led to structural transitions of social systems. Here, Leydesdorff provides us with a fascinating interpretation of social history in terms of increasing complexity and of the reinforcement of the reflexive dynamics allowed by faster means of communication. The transition to a global knowledge-based economy, where the social system is not any more hierarchically structured in nation states, is thus closely linked to the diffusion of new communication means allowing a much faster exchange of knowledge.

These theoretical reflections are the basis of the well-known triple helix model, which Leydesdorff has elaborated from the 1980s together with Henry Etzkowitz. Triple helix adds to the (traditional) institutional differentiation among universities, industries and governments, including their functional interfaces such as funding agencies or technology transfer offices, a reflexive layer where these institutions are interpreted and reshaped by human agents.

Thus, quite naturally, the last chapters of the book provide, after a thorough discussion of the triple helix model and of some recent criticisms of it, a framework for quantitative measurement of the triple helix phenomenon based on information theory and the idea of measuring mutual information among

the three subsystems. The focus is here more on the general methodology for constructing some indicators and on examples of their application than on a detailed discussion of data issues, for which the reader is invited to refer to more technical contributions.

However, already these applications give a glimpse of how, starting from a conceptual model, it is possible to design some simple, yet significant, quantitative measures from data that are to a large extent already available, such as publications and citations data, regional economic data or even information retrieved from Web search engines. As an application, the book contains two (already published) studies on the knowledge base of the Dutch and of the German economy respectively.

Finally, it should be said that the book as such has not the aim of providing original research results, since it is composed to a large extent of contributions that have been published in different journals and books during the last few years, but that have been thoroughly revised to fit them into a coherent line of argumentation. However, it provides the reader with a fairly concise introduction to the intellectual trajectory and research program of Leydesdorff, displaying clearly the internal coherence between its theoretical work on social systems on the one hand and the contributions more oriented towards the production of indicators and measurement of the science system on the other hand.

Even if I am usually rather skeptical about reprinting exercises, I think that this book is quite a useful read, especially for people engaged in quantitative science and technological studies, who need to consider the importance of sound theory and conceptual modeling for their work.

Katherine Hayles' third way towards posthumanity

Yu-Wei Lin

My Mother was a Computer: Digital Subjects and Literary Texts by N Katherine Hayles
University of Chicago Press, August 2005, 288 pages, US\$22, ISBN 0 226 32128 7

Following up on her book, *Writing Machines* (2002), which defines materiality as "an emergent property created through dynamic interactions between

physical characteristics and signifying strategies", Hayles' newest contribution enlarges our understanding of materiality as she aims to incorporate a Latourian version of "the constructions of matter that matter for human meaning" (page 3). It is through this perspective that she has readers embark on a journey of re/discovery of the multidimensional dynamic intermediation of literary texts in our digital life.

Hayle's work is divided into three distinct parts: "making", through language and code; "sorting", as print and electronic text; and, "transmitting" via analog and digital encoding. In the first section (making), she suggests that the operation of code is an

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intermediated product of human thought and machine intelligence undergoing processes through which texts emerge. She illustrates “how bodies are interpolated differently as the technology transforms from the passive code of the telegraph to the [executable]/active code of sophisticated cybernetic device and computer programming” (page 8).

The second part of her book (sorting), has Hayles exploring the materiality of a variety of forms of media (print and electronic text, language, code) by looking at the complex dynamics that emerge from the processes of “media translation” (page 89). For example, she examines what happens as you translate print literature into digital media and then move back and forth between these two realms. According to her account, technologies and texts interpenetrate mutually and constitute one another without doubt. She notes: “texts [are] more than sequences of words and spaces [but] artefacts whose materialities emerge from negotiations between their signifying structures and the technologies that produce them” (page 142).

Her third section (transmitting), deals with the fluid transmission between analog consciousness and digital cognition. Here, Hayles reviews how agency emerges via the intermediation and hybridisation of human and the machine. She argues emphatically that such hybridity would lead to the emergence of multiple subjectivities that appear in a virtual creature where human and non-human elements interact. This kind of material embodiment, which appears to be ubiquitous, bears an important meaning: “the entanglement of language with code, the traditional medium of print with electronic textuality, and subjectivity with computation [have] a major implication that the boundaries of all kinds have become permeable to the supposed other” (page 242).

In her epilogue Hayles concludes that “boundaries are both permeable and meaningful; humans are distinct from intelligent machines even while the two are become increasingly entwined”. She suggests that “rather than attempt to police these boundaries, we should strive to understand the materially specific ways in which flows across borders create complex dynamics of intermediation” (page 242). It is precisely this insightful view on boundaries that would enlighten policy-oriented researchers. The “new materialism” Hayles advocates puts an

emphasis on the mutable textuality of hybrid artefacts that allows them to be resituated and travel across boundaries.

Such fluidity opens up new and exciting possibilities for current discussions in digital culture studies, which have up to this point been largely built around the dichotomy between technological determinism and social determinism. Hayles encourages scholars to consider both the hybrid identities of digital artefacts (what she labels as “intelligent machines”) and human selves as situated subjects and objects that are embodied in the processes of interaction and accordingly instantiate mutually.

This perspective seems to offer unique insights for an investigation of the complex human–computer interactions in today’s web-based society. There seems to be a tremendous value in trying to incorporate this theoretical insight into the empirical study of communications, networks and communities in the present day semantically linked web 2.0 environment in which both human actors and digital artefacts are accommodated and where both human language and software code are assembled and co-evolved.

There is a great deal of work still to be done when trying to grapple with the subtleties of the hybrid and transitional life that we currently inhabit. Questions emerge such as: how do we deal with the uncertainties and dynamics emerging from mobility and fluidity of the multiple layers of transformation between the real and the virtual? I am confident that grounding Hayles’ theory in well-constructed studies of real life phenomena, particularly more policy-oriented case studies, would deepen our knowledge in this area and open up fruitful and engaging avenues for future exploration.

In sum, although Hayles’s writing owes much to the realm of literary studies, as opposed to directly relevant policy-oriented research, the concepts she raises in this book will be a valuable resource for any investigator who yearns for a new avenue of intellectual scholarship to help direct them through the sometimes messy but always interesting dilemmas of digital cultural studies.

References

Hayles, N K 2002. *Writing Machines*. Cambridge MA: MIT Press.