Journal of Futures Studies
2022, Vol. 26(4) 55-68
DOI: 10.6531/JFS.202206_26(4).0006

Article

Companion Modeling and "Committed Scenario-Building". For a Richer Taxonomy of Futures

Fabrizio Li Vigni[1*]

[1]*Sciences Po Saint-Germain-en-Laye, 5 rue Pasteur, 78100 Saint-Germain-en-Laye, France*

Abstract

The "Companion Modeling" community is a French association that gathers dozens of researchers in ecology, computer science and social sciences from France and the Global South. Its objective is to propose tools, such as debates, simulations and games, to administrations and local populations in order to deescalate conflictual situations involving the management of natural commons. ComMod's treatment of futures in the context of committed action-research is distinct. Existing taxonomies seem to neglect the specificity of their practices, whose main objective is pedagogic and empowering, not anticipatory nor predictive. ComMod anticipates the collapse of natural resources through very simple scenario-building, in order to raise awareness within a given community and push people to change their behaviors. The main contribution of this paper is to propose a novel term to describe this specific relationship to futures— "committed scenario-building"—which ComMod can be seen as a prototype of.

Keywords

Complexity Sciences, Scenarios, Simulation, Participation, Action-Research, Global South

Introduction

The "Companion Modeling" (or ComMod) community is a French association that is inscribed in "complexity sciences" (Waldrop, 1992), gathering some dozens of researchers in ecology, computer science and social sciences from France and the Global South (Étienne, 2010). They propose sophisticated action-research tools to administrations and local populations in order to deescalate conflictual situations involving the management of natural commons, such as the access to water, forest or fishing. "Commodians" use (among other tools) debates, serious games and agent-based simulations—a kind of digital modeling where a set of autonomous agents (individual or collective) are given a set of rules in a given environment, so as to observe their interactions and the evolution of the system in order to understand and/or predict its outcomes. "Commodians" are engaged researchers working in developing countries, who aim at fairer, more democratic and more sustainable ways of managing "socio-ecological complex systems"—a term referring to the intertwining of human, animal, vegetal and physical systems (Collectif ComMod, 2005; Étienne, 2012).

In their usage of simulations in the context of committed action-research, commodians take a particular approach to futures. How can we characterize this? To begin, we will compare the way ComMod handles futures to an existing "futures regimes" taxonomy proposed by two French sociologists Chateauraynaud and Debaz (2017). It includes "urgency", "expectation", "anticipation", "prediction", "prospective", "promise", "prophecy" and "science-fiction" (Chateauraynaud and Debaz, 2017). In this context, ComMod first appeared to us to be a combination of "anticipation" and "prospective" regimes (Li Vigni, 2020b). But the fundamental specificity of the commodians' practices was being neglected and made invisible by the use of these two categories. Namely, ComMod uses simulations to build scenarios whose main objective is pedagogic and empowering, not anticipatory nor predictive. More concretely, ComMod anticipates the collapse of natural resources through very simple scenario-building in

* *Corresponding author.*
E-mail addresses: Livignifabrizio@gmail.com (F. Li Vigni).

Received: 21 June 2021 and Accepted: 7 December 2021

order to raise awareness within a given community and push people to change their behaviors. In other words, the political value of ComMod simulations of the future needed a new term to be accurately described in their particularity. The main contribution of this paper is to add a novel sub-regime to Chateauraynaud and Debaz' taxonomy and to make sense of ComMod-like situations.

The first half of this article introduces and discusses Chateauraynaud and Debaz' taxonomy. It also proposes to complexify it by distinguishing between regimes and sub-regimes (a recapitulative overlook of which is given in Table 1). Some new sub-regimes are distinguished for the first time on the basis of precedent literature. The second half of the article describes ComMod, so as to illustrate its specific prospective activity—"committed scenario-building"—which it can be seen as a prototype of. This sub-regime consists of producing scenarios in order to modify the behavior of the different stakeholders and thus to correct a trajectory that is destined to catastrophe if nothing is done.

Materials and Methods

This article is inscribed in sociology of futures with a qualitative and interpretative approach. The posture is more descriptive than normative. The aim is to categorize the often implicit or unconscious ways in which scientists fabricate the futures and use them in certain ways within given social contexts. This is done by using existing taxonomies and by developing new ones.

The materials this article is built upon were gathered from "complexity sciences" (Waldrop, 1992; Helmreich, 1998; Williams, 2012; Li Vigni, 2018)—a field that is well known by foresight scholars as a source of conceptual inspiration (Sardar & Ravetz, 1994; Lo Presti, 1996; Smith, 2005; Wilkinson et al., 2013; Samet, 2013; Derbyshire, 2016; Andersson & Törnberg, 2018; Poli & Valerio, 2019). This interdisciplinary and transnational research domain reunites different sub-communities, which can be distinguished by their frameworks, normative views and futures regimes (Li Vigni, 2020b).

Among such groups, one is particularly interesting: it makes an original usage of futures scenarios, turning them into a trigger to produce educative and sociopolitical effects into the present. This is ComMod, which is the focus of this paper. The materials and methods to describe commodians include three groups of sources:

- A bibliographic analysis was conducted for complexity sciences in the US and Europe and for the ComMod community in particular. It includes scientific articles, a book and four grey literature reports from ComMod projects in different countries.
- For ComMod history and practices, six interviews were conducted with one of the founders based in France and with five second-generation members based in France, Brazil, Senegal and Burkina Faso. Questions concerned the intellectual and social origins of ComMod, its work in the field, the reaction to it of local communities, and the intellectual and political background of the interviewees. The recorded interviews lasted two hours on average. Some were conducted in face-to-face settings, others by video conference.
- Complexity sciences—which stay in the background as a yardstick—were investigated through a richer material, constituted of 115 interviews, fourteen laboratory visits and two institutional archives. Other publications tackle them in their globality from the historical and the sociological viewpoints[1].

The Taxonomy of Futures Regimes

> To think of the future of humanity is the challenge *par excellence* for every visionary spirit. Prolonging the historical events and the last advances of science, illustrious and unknown authors have imagined the futures using different literary styles. The prophecy mixes with science-fiction, the official forecasts with prospective elaborations or critical studies, and the corpus of future visions does not cease to extend. (Chateauraynaud & Debaz, 2017, p. 11).

With these words begins *On the edges of the irreversible* (2017), the book by French sociologists Francis Chateauraynaud and Josquin Debaz. In their text, the authors analyze the futures discourse on several topics—air pollution, nuclear energy, GMOs, nanotechnologies, etc.—and show that a plurality of trajectories always exists,

even when actors talk about irreversible processes. Nevertheless, the openness or the irreversibility of futures can be treated in different ways. To explore them, some fundamental questions must be asked:

1. How do the actors conceive time? In their eyes is it linear or non-linear, open or closed, slow or accelerating?
2. Which logic of action do these regimes imply? *i*) intervention in an ongoing process, relying upon background knowledge in order to anticipate what is next, *ii*) calculation of a linearized time in order to plan the future, or *iii*) production of scenarios because of future openness and uncertainty?
3. Do the actors work to build a desirable future or to thwart an undesirable one?
4. Last but not least, in which direction does the time arrow run according to the actors? Does it go from the present to the future, or the other way around (backcasting)?

To summarize all these questions, Chateauraynaud and Debaz (2017) have isolated three parameters— "time modeling" (how time is seen by actors), "logic of action" (how actors act depending on time modeling) and "prototypes" (paradigmatic examples of each regime)[2].

How many modalities of relating to futures are there? They are admittedly many, but not endless. To make sense of the discourses about futures that actors hold in different arenas, Chateauraynaud and Debaz offer a rich taxonomy of what they call "futures regimes", which include: "urgency", "expectation", "anticipation", "prediction", "prospective", "promise", "prophecy" and "science-fiction". The list is long, but its authors do not position it as definitive. Two more regimes have, in fact, been added in a recent paper: "high-frequency" and "optimization" (Li Vigni, 2020b).

These ten regimes may cover most of the discourses about futures that circulate in different arenas of the public space, from epidemic prediction to climate and energy scenario-building, from transhumanist promises to global collapse prophecies. However, the ComMod study case calls for a new aspect to be recognized and offers therefore an occasion to revisit Chateauraynaud and Debaz' taxonomy. This article further develops it by distinguishing between two levels of analysis—regimes and sub-regimes—and by introducing new categories under the "urgency", "anticipation" and "prospective" regimes.

Urgency. As Chateauraynaud & Lehtonen (2013, p. 7) write, in the "urgency" (or "emergency") regime, "visions of the future are produced under severe pressure, because everything plays out over a very short period of time, too short for the actors to evaluate, through deliberation, the different openings to the future". In this mode, action must take place quickly, in the context of a process which is difficult or impossible to control. Nevertheless, there are different time lengths and different ways of working under the urgency mode. Three sub-regimes can be proposed.

- The "low-frequency" sub-regime refers to situations in which a warning is launched as regards, for example, the end of a given resource in the energy or raw material sectors. It deals with a scale of years, from a few to some decades. Despite this, the discursive mode is still characterized by speediness because, if the warning is not considered seriously, the actors may find themselves unprepared when the shortages arrive.
- A second sub-regime is "medium-frequency"—characteristic of crises such as earthquakes, fires, or terrorist attacks. Time here is shorter and acting rapidly is necessary to save lives. Total control of events is impossible. Experts and authorities generally arrive too late, and their capacity to anticipate what's next is very limited. Water droughts can be seen as half-way between this and the first sub-regime.
- In the third place, the "high-frequency" mode describes the shortest of times. While "low-frequency" and "medium-frequency" generally imply efforts to react to a dangerous situation, the "high-frequency" implies the anticipation of a competition for gain. The work of those who live in a "high-frequency" regime consists in a visual navigation over a continuous flow, where time is divisible in ever-tinier pieces. Anticipation can hardly be done for the long term, but a slight advantage of a few milliseconds can change it all in the split between winners and losers. While military missions (mostly hyper-technological and more offensive than defensive) can be seen as a prototype of this mode, the latter was built up by studying a community that includes physicists, economists, and computer scientists whose objective is to employ chaos theory, machine learning and psychology in order to speculate in high-frequency trading (Li Vigni, 2020b). They propose methods to perform short-term predictions in order to increase speculative gains (Bass, 1999).

Expectation. The "expectation" (or "wait-and-see") regime "is almost the exact opposite of an emergency situation" (Chateauraynaud & Lehtonen, 2013, p. 7). It is described as a regime in which "time [is] suspended": "in the wait-and-see regime, the production of the future can be determined or undetermined depending on whether we

know what we are waiting for or whether we are waiting for something to happen to inspire us to take action". In this regime, "annoyance, impatience, loss of desire and weariness haunt those who wait. For example, we know how sentries quickly lose their watchfulness when they are constantly waiting for something to happen" (Chateauraynaud & Lehtonen, 2013, pp. 7-8).

Anticipation. We can talk about anticipation in a lay sense to refer "to all forward-looking attitudes and activities" (Poli, 2017, p. 1). On the other hand, according to Chateauraynaud and Debaz, anticipation refers to the often frenetic activity that societies do in threatening situations, where the need to prepare themselves becomes desirable. Anticipation can be seen as a more distended version of urgency. This regime can be subdivided into at least two sub-regimes.

- The work of epidemiologists, just like the work of national intelligence and other security agencies, belongs to a sub-regime that, in the words of American New Media scholar Richard Grusin, can be dubbed "premediation" (Grusin, 2010). Grusin introduced this term in order to inscribe media psychological "preparedness" to terrorism in a larger media and ideological context. Premediation serves to mentally prepare citizens for catastrophic events, so that they can be ready as soon as these occur. The stake is not to precisely predict the future, but to proliferate possible scenarios so as to anticipate surprise (Aradau & Van Munster, 2007). Scenario production—for example, in epidemiology—results from the complex articulation of all the different factors involved (Li Vigni, 2021b).
- Within the "anticipation" regime, the "premediation" attitude distinguishes from the "optimization" mode, which describes an orientation toward the future that implies invention and evolution for survival and gain. Its relation to time summons a constant and self-organized adaptation to an open future. The prototype of this sub-regime is a group of computer scientists and engineers who employ algorithms and robots in order to imitate evolution and to speed up industrial production (Li Vigni, 2020b). The actors who work in an optimization regime are less concerned than others by futures prediction, whilst being fully directed toward what is forthcoming. Future is for them assumingly opaque. The future is not preempted; it rather constitutes the riverbed of an adapting flow.

Prediction. The "anticipation" regime is not to be conflated with the "prediction" one. The latter has, indeed, an ambition to foretell the future in a more precise way than the former. As Chateauraynaud and Lehtonen (2013, p. 8) wrote, in "prediction" "the metrologies and spaces of calculation shared by the actors give modeling a central place in the construction of understandings of the future […] Prediction requires a relatively stable computational space with commensurable and computable parameters". The prototype of prediction is ballistics, that is, the field of mechanics that calculates the trajectory of an object in movement. Other prototypes are GDP or demographic growth predictions, although their efficacy is much more debated.

Prospective. By contrast, "prospective" or "foresight" activity implies "the production of different scenarios, allowing for the opening and exploring [of] the space of the possible" (Chateauraynaud & Lehtonen, 2013, p. 9). "[O]perating at a distance, [foresight] visualizes a plurality of futures to constrain reasoning and deliberation, and to make visible the expected cognitive and normative frames that make some future directions more plausible and more desirable than others" (Chateauraynaud & Lehtonen, 2013, p. 9). Foresight is used to affect phenomena, for example, in shaping policy or in engineering a device. We can distinguish at least three sub-regimes of the "prospective" regime.

- The "descriptive scenario-building" sub-regime refers to situations where experts build scenarios without intending to act upon the future, neither directly nor through political or other intermediates. The impact of the prospective in this case may be indirect: foresight producers leave others to draw conclusions from their work. Scenario-building can be formally descriptive but is always also normative. Sometimes this normativity is more visible, i.e. in deliberative contexts such as consensus conferences and other consulting spaces that institutions may put in place to collect citizens' suggestions (Joss & Durant, 1995; Giraudet et al., 2021). Suggestions are not formally binding for their receivers.
- "Operational scenario-building" refers to situations where experts build scenarios with the intention to act upon the future or to place somebody else in the position to do it. One can think of laboratories, agencies, lobbies, associations, NGOs, foundations and think tanks that put pressure on governments and enterprises or are contacted by them in order to tackle a given problem—say, the Covid-19 epidemics. In uncertain situations, political power tends to complement older with newer instruments (Aykut et al., 2019).

- Third, the "committed scenario-building" sub-regime refers to experts using future scenarios in action-research contexts with the idea of achieving a given outcome within a given framework (a forum, a workshop, a debate or other). A prototype of this mode is the "future workshops" developed by Robert Jungk and Norbert Muellert in the 1970s (Jungk & Muellert, 1987; Eickhoff and Geffers, 2006; Ørngreen and Levinsen, 2017). Lay citizens analyze current problems (criticism phase), develop suggestions (fantasy phase) and propose a concrete plan for change (realization phase). Another prototype of "committed scenario-building" is ComMod, described in the next section of the paper[3].

Promise. The future regime of "promise" has been well-studied by the field of Science and Technology Studies (van Lente, 1993; Brown & Michael, 2003; Borup et al., 2006). In "promise communities", hype appears as one of the core issues, for it informs actors' research practices, fundraising activities and institutionalization strategies. Promises become operational modes and self-fulfilling prophecies with the aim of achieving desired futures. A technoscientific or electoral promise can be motivational for the people that believe in it. In most cases, the active engagement of as many actors as possible is precisely the best way to make the promise come true: the "promise" regime depends on the critical mass that supports it. This regime thus distinguishes from "prophecy", which does not condition its success on a large participation of people. Put differently, prophecy asserts itself to be true no matter what we do, while promise engages its receivers as much as its established proponents.

Prophecy. "By definition, a prophecy announces an inescapable future, attributing determination to what seems to be fundamentally indeterminate" (Chateauraynaud & Lehtonen, 2013, p. 10). "Prophecy" does not concern only religious discourses—experts of all kinds can be producers of prophecy. In this regime, the discourse aims to have an effect similar to that of the "promise" regime, but the strategies that accompany the two are not the same. While in "promise" scientific entrepreneurs typically produce persuasive materials (roadmaps, proofs of concept, etc.) in order to persuade public authorities and/or businesses to fund their R&D, in "prophecy" experts may just spread their word through media in the hope of raising public opinion awareness.

Science-fiction. Finally, the "science-fiction" regime, not present in the first "futures matrix" proposed by Chateauraynaud (2013), was added to it by Chateauraynaud & Debaz (2017). This regime has been explored by novelists as well as scholars. What makes science fiction so interesting to futures research is that fictional narratives about possible forthcomings can sometimes spill out from the entertainment sphere and become objects of political debate, nourishing people's imaginations and actions. Science fiction can be a way to examine models of social change (Dolan, 2020; Nikolova, 2021) and to raise questions about unexpected consequences (Rumpala, 2021). Science fiction can advance serious hypotheses about the future by increasing the space of possibilities with innovative reasoning. It is particularly capable of opening up political discussions to new territories and of problematizing social problems, by tackling potential concatenations and consequences that have not yet been considered.

Table 1 below lists in a synthetic way the regimes and sub-regimes described in this section.

	Time modeling	Logic of action	Prototypes
Urgency	Time is short	Race against time to limit damages	Backup plan after an alert
– low-frequency	Years or decades	To prepare for shortages	End of a given resource
– medium-frequency	A few hours or days	Acting rapidly to save lives	Earthquakes, tsunamis, fires, terrorist attacks
– high-frequency	Each second counts	Visual navigation; uncertain anticipation in a very short time	High-frequency trading; military missions
Expectation	Suspended time	Continual displacement of expectation time	Blackout: waiting for the return to normality
Anticipation	Accelerated time	Action over an ongoing process; preparedness	Climate change
– premediation	Catastrophe can happen at any time	Scenario proliferation to avoid shock and surprise	Epidemics; terrorist attacks
– optimization	Adaptation to an open future	Automatization of a learning process; creative randomness	Machine learning; adaptive management
Prediction	Calculated and linearized time	Calculation space; planning	Ballistics; demographic models; GDP evolutions
Prospective	Time is non-linear and open	Scenarios production	Energetic scenarios
– descriptive scenario-building	Future is difficult/impossible to act upon	Scenarios production without direct intervention	Certain streams of futures studies
– operational scenario-building	Risky future is avoidable, if measures are taken	Scenarios production with direct intervention	Experts who make pressure on, or who are contacted by governments
– committed scenario-building	Bad trajectories can be corrected	Scenarios production to produce a given outcome	Future workshops (Jungk & Muellert, 1987); ComMod
Promise	Delay logic	Engaging in a promise; proving one's credibility	Biotechnologies; transhumanism; 5G; nuclear fusion
Prophecy	Eschatological time	Describing an inevitable future	The end of oil
Science-fiction	Fictional time	Opening up the space of possibilities through imagination	The collapse of Western civilization (Oreskes & Conway, 2014)

Table 1: Recapitulative overlook of futures regimes and sub-regimes

The Case of Companion Modeling's "Committed Scenario-Building"

ComMod history

ComMod is an association founded in 2003 by a dozen French researchers in computer, life and social sciences (Étienne, 2010). The group is inscribed in the "complexity sciences" label and operates through action-research workshops in the Global South (Rigg, 2007). According to its founding texts, the ComMod research approach is defined as a form of participatory geo-prospective technique (Emsellem et al., 2012), aiming at producing scientific knowledge about socio-ecological complex systems, while providing a democratic and sustainable management of renewable resources (Collectif ComMod & Bousquet, 2009; Étienne, 2012). While projects are mostly funded by French national research institutes (like CIRAD, IRD and CNRS), ComMod targets local communities and administrations who can refuse their services. Except for a few inside contributions aimed at improving ComMod framework (Barnaud, 2013; Daré, 2005; Richard-Ferroudji, 2008), this collective remains an uncharted territory for social sciences.

The history of ComMod starts in the first half of the 1990s. At that time, hydrologist and bio-mathematician François Bousquet were collaborating with economist Martine Antona and hydrologist Olivier Barreteau at the French International Center for Agronomic Research and Development (CIRAD). Their objective was to develop a novel approach for the interdisciplinary management of fishery in Senegal. In 1996, Bousquet and Barreteau proposed the idea of a "companion approach" to oppose the "knowledge transfer approach" (dominant in those days), which they describe as top-down and deleterious for the so-called beneficiaries. For these scholars, it was not

a matter of bringing northern scientific knowledge to developing countries, but of putting "stakeholders" around a table in order to accompany and help them decide autonomously. ComMod stakeholders could be socio-professionals, activists, technicians, experts and administrators.

Such an approach rapidly attracted some of their colleagues at CIRAD, so in 2003 the group founded the Companion Modeling association. By now it features more than forty members, coming from France and other countries in the world, who have been active in more than sixty study cases in several countries (such as Laos, Cambodia, Senegal, Brazil, etc.), around multiple issues (such as management of water bodies, national frontiers, forests, fishery, natural parks, etc.)[4]. Members include computer scientists, ecologists, agronomists, geographers, anthropologists, economists and sociologists. Commodians propose a variety of tools depending on their projects: non-scientific verbal diagnosis, scientific formal representations, maps, serious games (Piveteau, 1994), audits, legal expertise, as well as agent-based modeling.

ComMod digital tools

Among complexity tools, ComMod has a predilection for agent-based modeling (ABM), originally developed at the Santa Fe Institute by American computer scientist Christopher Langton (Langton, 1997) or, more often, for the French equivalent but different technique of multi-agent systems (MAS) (Ferber, 1999). By their conceivers and users, ABM and MAS are described as rich and flexible research tools, and since the end of the 1980s they have been applied to all kinds of study objects in different disciplines, from forests to ecosystems, from energy grids to financial markets. Agents can number from some dozens to several millions and are thought of as autonomous, reactive and pro-active, goal-directed entities, which are constrained by a set of rules and a given environment that can be simplified or realistic (Niazi & Hussain, 2011; Wilensky & Rand, 2015). The objective of these simulations is to obtain some insight into the real-world situation being modeled. Such an insight can be multi-fold, depending on the researchers' aims and discipline, and can either concern its functioning (comprehension) or its evolution (anticipation).

Initially ABM/MAS were used as toy models for physical and biological systems (Langton, 1989). Soon after, they were used to reconstruct the past of lost civilizations and to test archaeological (Kohler & Gumerman, 2000), economical (Tesfatsion, 2003) and sociopolitical theories (Axelrod, 1997; Epstein & Axtell, 1996). Finally, later on they became predictive tools for anticipating phenomena such as epidemic outcomes (Ajelli et al., 2010), or adaptive exploration tools for business problem-solving (Bonabeau & Meyer, 2001) and drug design (Bonabeau et al., 2008). In short, ABM/MAS can be fed with real or fictive data in order to explore, explain, design, anticipate, prospect and predict real world systems.

To build on this, commodians have developed a special kind of ABM/MAS that they have dubbed Hybrid Agent-based Modeling or HAM. In most ABM/MAS implementations, humans and non-humans (such as animals and plants) are represented as agents lacking an overall knowledge of the system they belong to, but capable of perceiving and reacting to their immediate surroundings. In this frame, only the scientist can have a panoramic regard on the whole they model. Instead, ComMod conceives ABM/MAS in an interactive way, so that stakeholders can acquire an overall view of the system by handling the simulation directly or indirectly. Sometimes participants can play a video game with a joystick; at other times their decisions are collected verbally and then digitally implemented by a modeler.

HAM includes at least five functions: 1) the visualization of the space, 2) the simulation of the resource dynamics, 3) the calculation of agents' interactions indicators, 4) the specification of non-human agents' behavior by inserting available or plausible data, 5) and, most importantly, the possibility to let stakeholders insert their own decisions into the model. In the latter case, a decision can be taken 1) by a human agent, 2) by a human agent mediated by an informatic agent, 3) by a human agent and an informatic agent, or 4) by an informatic agent alone (Étienne, 2010, p. 75).

ComMod normative approach

In order to understand the ComMod take on futures, it is also necessary to present its intellectual and political background. Once on the field, commodians collect information from stakeholders in order to build up a model of

the conflictual situation in which they are implicated and to "co-construct" scenarios with them. In this process, commodians see themselves as "mediators" between different cultures and interests, while the simulation is in charge of mediating between different scales (local, regional, national, international), as well as between different kinds of knowledge (scientific disciplines, agronomy, policy, etc.). Frequently, ComMod projects are organized by a binomial composed of an expert in a given field and a computer scientist whose main task is digital modeling. The process is conceived as circular (Figure 1).

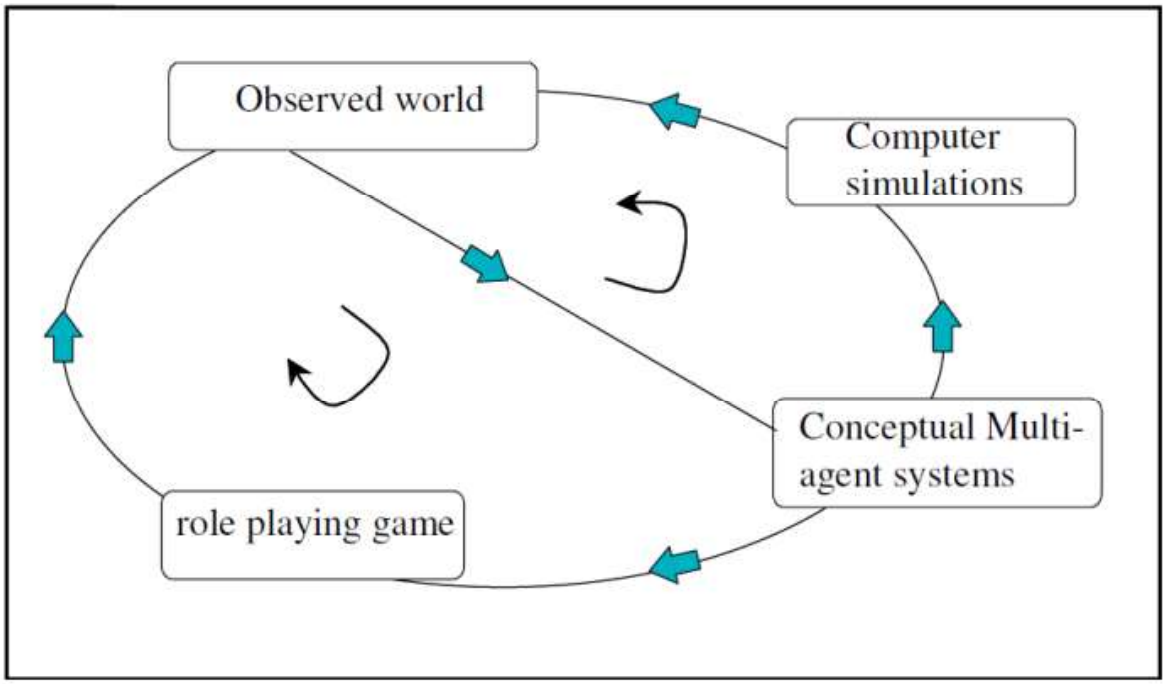

Fig. 1: ComMod implements a cyclic and iterative process. Source: Barnaud et al., 2006.

The observation of the world permits the design of the model, which gives rise to a role-playing game and to a simulation, which are liable, in their turn, to change the observed world, so that the cycle can start over again. In other words, ComMod members have an explicit political take on their tools and the role of their research, and think that the role of researchers is to effectively change the systems in which they operate.

Within the ComMod framework, scientists are conceived as engaged technicians and mediators among different cultures, bodies of knowledge and diverging interests. In most cases, commodians are motivated to find possible solutions to "the tragedy of the commons where collective goods are exploited to the point of exhaustion because profits are individualized and costs are shared" (Bonnefoy et al., 2000, p. 163). While commodians wish not to prescribe actors with the "best" decision, they explicitly refuse individualism and competition as the structural principles of social interaction, and criticize fake participative devices: "Stakeholder engagement, collaboration, or participation, shared learning or fact-finding, have become buzz words […] This is clearly a positive development, but in far too many cases stakeholders have merely been paid lip service" (Voinov & Bousquet, 2010).

Commodians systematically refer to bodies of knowledge that are engaged in social transformation. Firstly, with a reference to the post-normal science paradigm (PNS)—used in contexts where knowledge is uncertain, values are in debate, stakes are high and decisions are urgent (Funtowicz & Ravetz, 1993; Strand, 2017)—ComMod promises to achieve symmetry through the deployment of a number of techniques and the involvement of stakeholders in the decision process. Inter- and transdisciplinary knowledge, environmental durability, expertise democratization and extended peer review (beyond the circle of certified experts) constitute some of the fundamental concepts and aims

of ComMod. In line with PNS, ComMod also claims to focus on the quality of the decision-making more than on the quality of the decision itself: "Within the post-normal frame, the objective of the researchers is to propose as rich and equitable a concertation arena as possible. […] local actors' adhesion […] to such an arena challenges its legitimacy and conducts the conceiver of the initiative to question him or herself" (Étienne, 2010, p. 143).

As a consequence, ComMod workshops are conceived to become symmetrical spaces where knowledge and decision are *by design* as equally distributed and valorized as possible. Commodians seek to implement ways to limit the power of the strongest (men, administrators, higher social classes) and to empower the weakest (women, farmers, poor social classes) (Barnaud, 2013). They invoke a neutral attitude, but not in the sense that their approach is a positivistic endeavor without sociopolitical objectives. As a French geographer from CNRS clearly explained: "[We face] an ideological question, because to think that a system must produce equality or inequality is a choice" (interview, 10.03.17).

In particular, commodians' claim to neutrality has a triple normative objective: increasing democracy, guaranteeing justice and fostering environmental durability. ComMod seeks to provide individual agents with knowledge about the system they form part of, in order to empower them. Besides PNS, the "patrimonial mediation" approach proposes to be an "efficient" and "legitimate" methodology to manage renewable resources in a complex, multi-actor context (Ollagnon, 1999; Mermet et al., 2005). By considering nature as a common good, this framework aims at overcoming the "limits" of the economic, ecological and techno-institutional approaches when attempted alone.

According to Ollagnon and Mermet, classical approaches were based on 1) one decision maker, 2) a rigid and static approach to the problems, 3) the absence of negotiation, and 4) a localized problem-solving attitude. Conversely, patrimonial mediation claims to stand upon 1) a plurality of actors, 2) a dynamic and relational approach to problems, 3) negotiation as the main principle of management, and 4) a long-term inter-generational breadth.

Other important methodological and normative sources for commodians are:

- American economist Elinor Ostrom's approach on the common goods management (Ostrom et al., 1994), focused on the efficacious allocation of resources in small communities, which self-govern through the establishment of social norms based on decentralized sanctions;
- British historian Robert Chambers' participatory rural appraisal (Chambers, 1994), which aims to incorporate the knowledge and opinions of rural people in the planning and management of development projects and programs;
- And Dutch agronomist Niels Röling's social learning approach (Röling & Wagemakers, 1998), based on the idea that shared learning of interdependent stakeholders is a key mechanism for arriving at more desirable solutions to complex problems in rural environments (Collectif ComMod & Bousquet, 2009).

According to these movements, human beings are seen as free but dominated agents capable of handling their collective destiny in a peaceful and democratic way. As a French ComMod agronomist based in Brazil explained, commodians' political sources of inspiration vary from "de-growth" and "frugal economy" advocates (Partant, 1999; Schumacher, 1975; Latouche, 2010) to emancipatory pedagogies vowing to "empower the dominated" (Freire, 1996), passing by ecological economics which aims to integrate humans into ecosystems (Martinez-Alier & Muradian, 2015) (interview, 08.03.19).

ComMod take on futures

Now that we have clearly established that commodians are engaged scientists who wish to help people in problematic situations resolve them, we can examine their specific take on futures.

When playing the simulation, stakeholders and modelers produce different what-if scenarios. The dominant future regime is thus "prospective", because time is non-linear and the dynamic is not predetermined. The logic of action implies the production of a series of trajectories, which serve to address possible strategies and their consequences. One of these futures is the continuation of business as usual, which in most cases risks bringing the community toward environmental collapse and/or toward conflict and war. HAMs serve to highlight the (often catastrophic) consequences of present actions—which can be the over-exploitation of a resource, or the individualistic "first-come first-served basis" in the management of a natural good.

As one of the founders of ComMod explained: "If a MAS is the equivalent of a role game, we can play this game

and, through that, people can understand the model. And if they understand the model, they are then capable of taking a look at the computer interface in order to build the simulations with us" (interview, 17.05.19). ComMod tools can show that, if the actions of community members are not modified, fish will be depleted, forests razed, rivers polluted, and tensions can follow (interview with a Senegalese ComMod sociologist based in Burkina Faso, 19.01.18). For commodians, the simulation is not charged with forecasting, but with showing stakeholders the causal links at work within the systems they are embedded in. Simulations are expected to reproduce and show the interrelations between participants:

> The social and ecological systems we study are complex objects and, in consequence, accompanying the decision-making process does not consist of trying to predict the future state of the system. It is […] a matter of understanding [the] organization [of the socio-ecological system under study], of envisaging the desirable organizations, of facilitating the system interactions that head the change, of following it continuously […] in order to be able to propose some adaptations. (Étienne, 2012, p. 10).

Even if ComMod works with futures and talks about scenarios, foresight is less important than the pedagogical impact that the simulation can have on stakeholders. Workshops serve to explore the logical consequences of "business as usual" at a rough level. They allow participants to test and evaluate the outputs of their actions: What happens in ten years if I continue to act like I do today? What instead if I manage the resource differently? In other words, ComMod intends to act as a mirror to a micro-society, which can then gain self-awareness to better self-organize. HAM's epistemic function is thus less explanatory or anticipatory rather than *revelatory*; ComMod scenario-building is less descriptive or operational rather than *committed*. Descriptive scenario-building adopts an observational posture, while operational scenario-building adopts an active attitude. For its part, committed scenario-building is situated somewhat in the middle. As a French agronomist based in Brazil explained:

> Farmers are interested in our game because they normally exchange little with others about the way they take decisions […] It makes them think and exchange about their practices […] Sometimes they discuss at the Church, sometimes they swap plants. But they rarely talk about long-term planification of their properties. (Interview, 08.03.19).

While other complexity scientists follow Friedrich von Hayek's idea, according to which individuals cannot know the whole and have no take on it (Vriend, 1999; Kilpatrick, 2001), commodians believe that humans can be, but not necessarily are, masters of their collective destiny, and should be helped to achieve it. For them, if people are sat around a table to grasp the whole picture, they may prioritize cooperation over competition. In the ComMod view, by making scenarios, stakeholders can understand the global dynamics of the system they live in and can thus co-organize to preserve the resources they depend on. While for Hayekian complexity specialists society is an aggregate of individuals, selfishly competing for their own good, commodians think that people can conceive strategies to reach common *and* individual objectives—like in Senegal where fishing has to be suspended periodically so as to let the fish breed (interview with a French ComMod modeler based in Senegal, 31.07.18). In the ComMod perspective, scientists are still conceived as *dei ex machina* who help stakeholders find the way toward the "good" future; however, they are not seen as super-experts who bring them the ultimate solution (Verrax, 2017).

Conclusion

ComMod challenges Chateauraynaud and Debaz' taxonomy of futures regimes and calls for a new, specific term to describe its specificities. In the first section of this article, we have proposed to augment the futures regimes taxonomy by introducing some new sub-regimes. "Urgency" is now subdivided into "low-frequency" (preparing to shortages of resources to come in a few years or decades), "medium-frequency" (acting rapidly to limit damages in critical situations like earthquakes or terrorist attacks) and "high-frequency" (visual navigation in a continuous flow where each second counts); "anticipation" is now subdivided into "premediation" (scenario proliferation to avoid surprise) and "optimization" (automatization of a learning process to adapt to an open future); "prospective" is now divided into "descriptive scenario-building" (where experts scenarize the future without intending to act upon it

directly), "operational scenario-building" (where experts scenarize the future to act upon it directly or to allow somebody else to do it) and "committed scenario-building" (where experts use scenarios less to anticipate than to produce sociopolitical learning and change).

What is ultimately the sense of the intellectual approach adopted here? Instead of falling into one-way narratives where "Humanity" is reduced to an undifferentiated "us", it is more pertinent to respect the complexity of social reality and to account for the diversity of social processes through appropriate concepts. To this end, analytical taxonomies like the one presented in these pages can help scholars, citizens and administrators to better tackle these three fundamental questions of our times: "How did we get here? What futures are open to us? What can we do now?" (Chateauraynaud & Debaz, 2017, p. 572). Acknowledging and describing the plurality of perspectives that are present in society has not only epistemic but also political virtues, for they may increase scientific understanding as well as democratic imagination and agency.

Notes

- Li Vigni (2020a, 2021a).
- They also talk about the "forms of critique" the regimes are subject to, but this will be left out for lack of room.
- Futures scholars who propose scenario-building for pedagogical reasons can be situated somewhere in the middle between "committed scenario-building" and "descriptive scenario-building". Engaged in social change, they do not produce it immediately like in ComMod workshops—as a result of which decisions in the management of a resource are modified—but through the mediation of education (Cederquist & Golüke, 2016).
- https://www.commod.org/qui-sommes-nous/adherents.

References

Ajelli, M., Gonçalves, B., Balcan, D. et al. (2010). Comparing large-scale computational approaches to epidemic modeling: Agent-based versus structured metapopulation models. *BMC Infect Dis*, *10*(190). https://doi.org/10.1186/1471-2334-10-190

Andersson, C., & Törnberg, P. (2018). Wickedness and the anatomy of complexity. *Futures*, *95*, 118-138.

Aradau, C., & Van Munster, R. (2007). Governing Terrorism Through Risk: Taking Precautions, (un)Knowing the Future. *European Journal of International Relations*, *13*(1), 89-115.

Aykut, S. C., Demortain, D., & Benbouzid, B. (2019). The Politics of Anticipatory Expertise: Plurality and Contestation of Futures Knowledge in Governance—Introduction to the Special Issue. *Science & Technology Studies*, *32*(4), 2-12.

Barnaud, C. (2013). La participation, une légitimité en question. *Natures Sciences Sociétés*, *21*(1), 24-34.

Bass, T.A. (1999). *The predictors: How a band of maverick physicists used chaos theory to trade their way to a fortune on Wall Street*. Henry Holt & Company.

Bonabeau, E., & Meyer, C. (2001). Swarm intelligence. A whole new way to think about business. *Harv Bus Rev*, *79*(5), 106-14.

Bonabeau, E., Bodick, N., & Armstrong, R. W. (2008). A more rational approach to new-product development. *Harvard Business Review*, *86*(3), 96–102.

Bonnefoy, J.L., Le Page, C., Rouchier, J., & Bousquet, F. (2000). Modelling spatial practices and social representations of space using multi-agent systems. *Advances in Complex Systems*, *3*(01n04), 155-168. https://doi.org/10.1142/S0219525900000121

Borup, M., Brown, N., Konrad, K., Van Lente, H. (2006). The sociology of expectations in science and technology. *Technology Analysis & Strategic Management*, *18*(3-4), 285-298.

Brown, N., & Michael, M. (2003). A sociology of expectations: retrospecting prospects and prospecting retrospects. *Technology Analysis and Strategic Management*, *15*(1), 3-18.

Cederquist, A., & Golüke, U. (2016). Teaching with scenarios: a social innovation to foster learning and social change in times of great uncertainty. *European Journal of Futures Research*, *4*(1), 1-8.

Chambers, R. (1994). The origins and practice of participatory rural appraisal. *World Development*, *22*(7), 953-969.

Chateauraynaud, F. (2013). Des prises sur le future. Regard analytique sur l'activité visionnaire. In Bourg, D., Joly, P.-B., & Kaufmann, A. *Du risque à la menace*. PUF, 287-310.

Chateauraynaud, F. & Debaz, J. (2017). *Aux bords de l'irréversible. Sociologie pragmatique des transformations*. Pétra.

Chateauraynaud, F. & Lehtonen, M. (2013). Arguing the future. Debates on energy in Europe: programmes, scenarios and prophecies. *IPA conference, Vienna, 3-5 July 2013*: https://www.academia.edu/4452307/Arguing_the_future_Debates_on_energy_in_Europe_programmes_scenarios_and_prophecies_with_Markku_Lehtonen_june_2013_

Collectif ComMod (2005). La modélisation comme outil d'accompagnement. *Natures Sciences Sociétés*, *13*, 165-168.

Collectif ComMod, & Bousquet, F. (2009). La posture d'accompagnement des processus de prise de décision: les références et les questions transdisciplinaires. In: Hervé, D., & Laloë, F. (eds). *Modélisation de l'environnement: entre natures et sociétés*. Editions Quæ, 71-89.

Daré, W. (2005). *Comportements des acteurs dans le jeu et dans la réalité: indépendance ou correspondance? Analyse sociologique de l'utilisation de jeux de rôles en aide à la concertation*. PhD Thesis, AgroParisTech.

Derbyshire, J. (2016). The implications, challenges and benefits of a complexity-orientated Futures Studies. *Futures*, *77*, 45-55.

Dolan, T. (2020). Science Fiction as Moral Allegory. *Journal of Futures Studies*, *24*(3), 105-112.

Eickhoff, P., & Geffers, S.G. (2006). *Power of Imagination Studio—A Further Development of the Future Workshop Concept*. In: Holman, P., Devane, T., & Cady, S. (eds.). *The Change Handbook—The Definitive Resource on Today's Best Methods for Engaging Whole Systems—2nd edition*. Berrett-Koehler Publishers.

Emsellem, K., Liziard, S., & Scarella, F. (2012). La géoprospective: l'émergence d'un nouveau champ de recherche? *L'Espace géographique*, *41*(2), 154-68.

Epstein, J.M., & A*xtell, R.L. (1996). Growing Artificial Societies: Social Science From the Bottom Up. MIT/Brookings Institution.*

Étienne, M. (ed) (2010). La modélisation d'accompagnement: une démarche participative en appui au développement durable. Quæ éditions.

Étienne, M. (2012). La modélisation d'accompagnement: une forme particulière de géoprospective. *L'Espace géographique*, *41*(2), 128-37.

Ferber, J. (1999). *Multi-Agent System. An Introduction to Distributed Artificial Intelligence*. Addison Wesley Longman.

Freire, P. (1996). *Pedagogy of the oppressed*. Penguin.

Funtowicz, S.O., & Ravetz, J.R. (1993). Science for the post-normal age. *Futures*, *25*(7), 739-55.

Giraudet, L. G., Apouey, B., Arab, H., Baeckelandt, S. et al. (2021). *Deliberating on Climate Action: Insights from the French Citizens' Convention for*. Working Paper, hal-03119539: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiRh9_L3_zzAhVCJhoKHbQBAx0QFnoECAIQAQ&url=https%3A%2F%2Fhal-enpc.archives-ouvertes.fr%2Fhal-03119539%2Fdocument&usg=AOvVaw1spzRRN3m-kWuOx5Gu3axB.

Grusin, R. (2010). *Premediation: Affect and Mediality After 9/11*. Palgrave Macmillan, London.

Helmreich, S. (1998). *Silicon Second Nature. Constructing Artificial Life in a Digital World*. University of California Press.

Joss, S., & Durant, J. (eds.). (1995). *Public participation in science: The role of consensus conferences in Europe*. NMSI Trading Ltd.

Jungk, R., & Muellert, N. (1987). *Future workshops: How to Create Desirable Futures*. Institute for Social Inventions.

Kilpatrick, H.E. (2001). Complexity, Spontaneous Order, and Friedrich Hayek: Are Spontaneous Order and Complexity Essentially the Same Thing? *Complexity*, *6*(3), 16-20.

Kohler, T.A., & Gumerman, J.G. (2000). *Dynamics of Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes*. Oxford University Press.

Langton, C.G. (1989). *Artificial Life: The proceedings of an interdisciplinary workshop on the synthesis and simulation of living systems, held September, 1987, in Los Alamos, New Mexico*. Addison-Wesley.

Langton, C. (ed) (1997). *Artificial Life. An Overview*. MIT Press.

Latouche, S. (2010). *Le pari de la décroissance*. Fayard/Pluriel.

van Lente, H. (1993). *Promising technology. The dynamics of expectations in technological developments*. PhD dissertation, University of Twente, Enschede.

Li Vigni, F. (2018). *Les systèmes complexes et la digitalisation des sciences. Histoire et sociologie des instituts de la complexité en France et aux Etats-Unis*. PhD dissertation, Ecole des Hautes Etudes en Sciences Sociales, Paris.

Li Vigni, F. (2020a). The failed institutionalization of "complexity science:" A focus on the Santa Fe Institute's legitimization strategy. *History of science*, 59(3), 344-369.

Li Vigni, F. (2020b). Five anticipation communities in complex systems sciences. *Futures*, 120, 102551.

Li Vigni, F. (2021a). Complexity sciences: A scientific platform. *Science & Technology Studies*, doi: 10.23987/sts.97027.

Li Vigni, F. (2021b). L'épidémiologie computationnelle à l'ère de la COVID-19. Enjeux disciplinaires et politiques d'une spécialité fondée sur l'étude des réseaux. *Reseaux*, 4(228), 23-60.

Lo Presti, A. (1996). Futures research and complexity: a critical analysis from the perspective of social science. *Futures*, *28*(10), 891-902.

Martinez-Alier, J., & Muradian, R. (eds). (2015). *Handbook of Ecological Economics*. Edward Elgar Publishing.

Mermet, L., Billé, R., Leroy, M. et al. (2005). L'analyse stratégique de la gestion environnementale: un cadre théorique pour penser l'efficacité en matière d'environnement. *Natures Sciences Sociétés*, *13*, 127-37. https://www.cairn.info/revue-natures-sciences-societes-2005-2-page-127.htm

Niazi, M., & Hussain, A. (2011). Agent-based computing from multi-agent systems to agent-based models: a visual survey. *Scientometrics*, *89*(2), 479-499. https://doi.org/10.1007/s11192-011-0468-9

Nikolova, B. (2021). The Science Fiction-Futures Studies Dialogue: Some Avenues for Further Exchange. *Journal of Futures Studies*, *25*(3), 93-98.

Ollagnon, H. (1999). *Une approche patrimoniale de la gestion de la qualité: une application à la nature et au vivant. Pour une écologie de l'action*. PhD Thesis, Université Paris 1.

Oreskes, N., & Conway, E.M. (2014). *The collapse of Western civilization: A view from the future*. Columbia University Press.

Ørngreen, R., & Levinsen, K. (2017). Workshops as a Research Methodology. *Electronic Journal of E-learning*, *15*(1), 70-81.

Ostrom, E., Gardner, R., & Walker, J. (1994). *Rules, games, and common-pool resources*. University of Michigan Press.

Partant, F. (1999). *La fin du développement. Naissance d'une alternative?* Actes Sud.

Piveteau, V. (1994). *L'avenir à long terme des zones rurales fragiles, approche par le jeu prospectif d'une question complexe*. PhD Thesis, Université Paris 1.

Poli, R. (2017). *Introduction to anticipation studies*. Springer.

Poli, R., & Valerio, M. (2019). *Anticipation, Agency and Complexity*. Springer.

Richard-Ferroudji, A. (2008). *L'appropriation des dispositifs de gestion locale et participative de l'eau. Composer avec une pluralité de valeurs, d'objectifs et d'attachements*. PhD Thesis, École des Hautes Etudes en Sciences Sociales.

Rigg, J. (2007). *An everyday geography of the global south*. Routledge.

Röling, N.G., & Wagemakers, M.A.E. (eds) (1998). Facilitating Sustainable Agriculture: Participatory Learning

and Adaptive Management in Times of Environmental Uncertainty. Cambridge University Press.

Rumpala, Y. (2021). Science fiction, reconfigured social theory and the Anthropocene Age: Exploring and thinking about planetary futures through fictional imaginaries. *Global Discourse: An Interdisciplinary Journal of Current Affairs*, *11*(1–2), 245–266.

Samet, R.H. (2013). Complexity, the science of cities and long-range futures. *Futures*, *47*, 49-58.

Sardar, Z., & Ravetz, J.R. (1994). Complexity: fad or future? *Futures*, *26*(6), 563-567.

Schumacher, E.F. (1975). *Small is Beautiful: Economics as if People Mattered*. Perenial Library/Harper & Row.

Strand, R. (2017). Post-normal science. In C.L. Spash (ed.), *Routledge Handbook of Ecological Economics: Nature and Society* (pp. 288-298). Routledge.

Smith, A.C.T. (2005). Complexity theory for organisational futures studies. *Foresight*, *7*(3), 22-30.

Tesfatsion, L. (2003). Agent-based Computational Economics: Modeling Economies as Complex Adaptive Systems. *Information Sciences*, *149*(4), 262-268. https://doi.org/10.1016/S0020-0255(02)00280-3

Verrax, F. (2017). Engineering ethics and post-normal science: A French perspective. *Futures*, *91*, 76-79.

Voinov, A., & Bousquet, F. (2010). Modelling with Stakeholders. *Environmental Modelling & Software*, *25*(11), 1268-1281. https://doi.org/10.1016/j.envsoft.2010.03.007

Vriend, N.J. (1999). Was Hayek an ACE? *Queen Mary and Westfield College Working Paper No. 403*. https://ssrn.com/abstract=185650.

Waldrop, M.M. (1992). *Complexity. The Emerging Science at the Edge of Order and Chaos*. Simon & Schuster Paperbacks.

Wilensky, U., & Rand, W. (2015). *An Introduction to Agent–Based Modeling. Modeling Natural, Social, and Engineered Complex Systems with NetLogo*. MIT Press.

Wilkinson, A., Kupers, R., & Mangalagiu, D. (2013). How plausibility-based scenario practices are grappling with complexity to appreciate and address 21st century challenges. *Technological Forecasting and Social Change*, *80*(4), 699-710.

Williams, L. (2012). *Modeling, Building, Writing: A History of Nonlinear Dynamics and Complex Systems*. PhD Thesis, Harvard University.