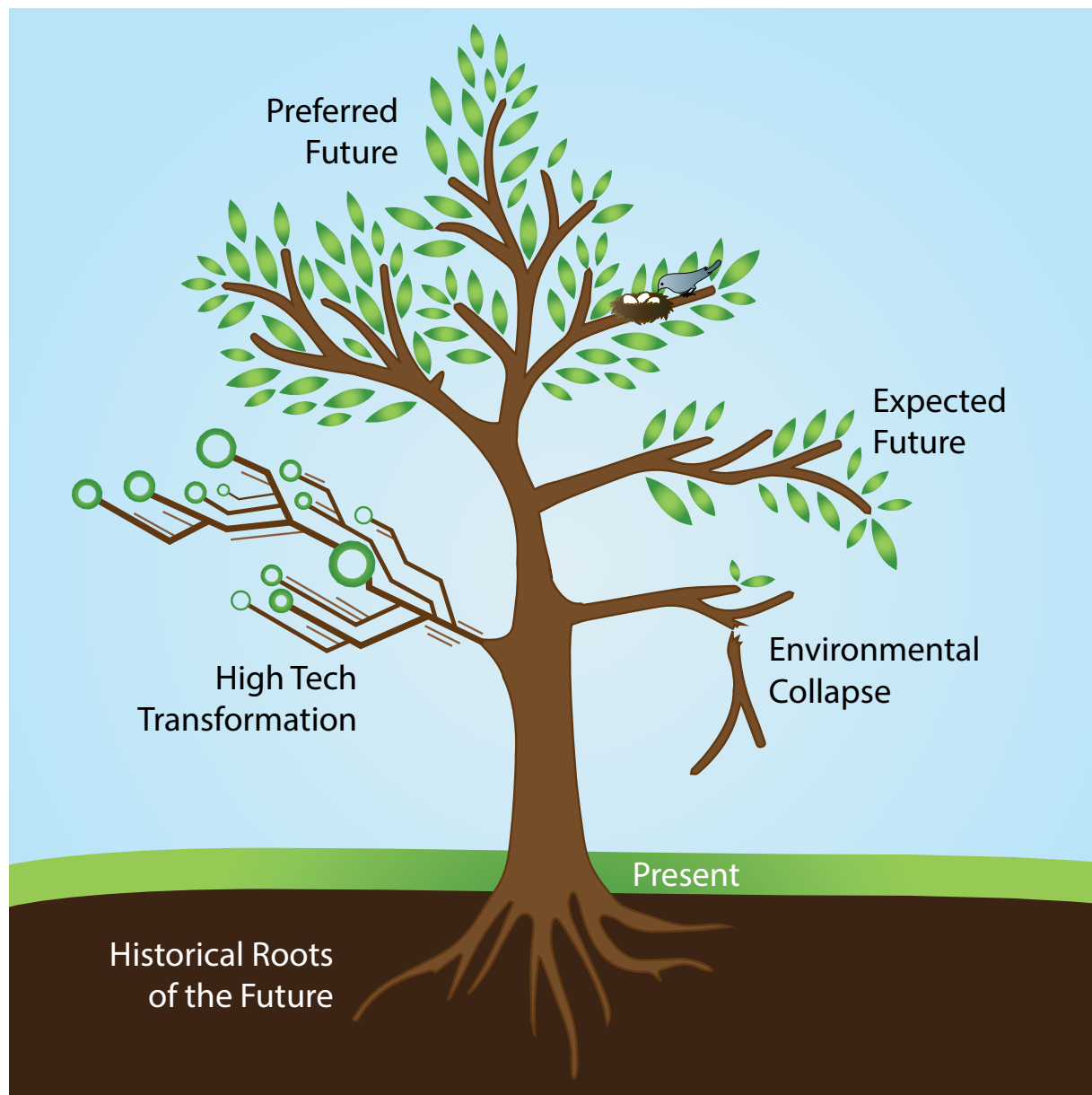


Ten Principles for Thinking about the Future: a Primer for Environmental Professionals

David N. Bengston



Abstract

Every decision we make is about the future, but most of us are never taught how to think critically about it. This guide addresses this issue by identifying and reviewing 10 principles for thinking about the future, along with related strategies for improving environmental foresight. The principles and strategies are drawn from the transdisciplinary field of futures studies. Taken together, these principles and strategies can help guide environmental planners, managers, and policy makers toward well-considered expectations for the future.

The Author

DAVID N. BENGSTON is a research social scientist and environmental futurist with the U.S. Forest Service, Northern Research Station, 1992 Folwell Avenue, St. Paul, MN 55108, dbengston@fs.fed.us.

Acknowledgments

The author thanks George Kubik, Andy Hines, Lynne Westphal, and an anonymous reviewer for many helpful comments and suggestions on an earlier version of this paper.

Cover Art

Tree with limbs representing plausible futures. Artwork by Haley Anderson, used with permission.

Quality Assurance

This publication conforms to the Northern Research Station's Quality Assurance Implementation Plan which requires technical and policy review for all scientific publications produced or funded by the Station. The process included a blind technical review by a reviewer who was selected by the Assistant Director for Research and unknown to the author. This review policy promotes the Forest Service guiding principles of using the best scientific knowledge, striving for quality and excellence, maintaining high ethical and professional standards, and being responsible and accountable for what we do.

Manuscript received for publication 8 August 2017

Published by
U.S. FOREST SERVICE
11 CAMPUS BLVD SUITE 200
NEWTOWN SQUARE PA 19073
December 2017

For additional copies:
U.S. Forest Service
Publications Distribution
359 Main Road
Delaware, OH 43015-8640
Fax: (740)368-0152
Email: nrspubs@fs.fed.us

CONTENTS

Introduction	1
1. The Future is Plural	3
2. The Future is Possible, Plausible, Probable, and Preferable	5
3. The Future is Open	7
4. The Future is Fuzzy	8
5. The Future is Surprising	10
6. The Future is <i>Not</i> Surprising	11
7. The Future is Fast.....	13
8. The Future is Slow	15
9. The Future is Archetypal.....	16
10. The Future is Inbound.....	18
Conclusions	19
Literature Cited	21

“[A]ll decisions are about the future.”

~ Kenneth Boulding (1973: v)

INTRODUCTION

History is a required subject in school, and rightly so. We need to understand the forces that have shaped the past and present. History is taught from elementary school through college. Some environmental and natural resource professionals have even had a course in environmental history. But very few have had a single class—or even a short course—in futures studies or strategic foresight. Most have never heard of these terms. We have not been taught principles for thinking about the future or strategies for improving foresight, despite the critical importance of clear forward thinking for our personal, professional, organizational, and societal success. Every decision we make is about the future, every policy and plan is based on implicit or explicit assumptions about the future, but the vast majority of students in educational systems around the world are never taught how to think critically about it (Bishop and Hines 2012, Lum 2016). Instead, we develop intuitions about the future informally through popular culture, which is filled with fanciful and recycled images and ideas. These have been called legacy futures (Cascio 2012) and used futures (Inayatullah 2008)—ideas that emerged decades ago and are stuck in our heads as default images. Legacy futures related to nature and natural resource management derive from many sources, including classic environmental literature. Persistent images of the future of nature and our relationship with the natural world include:

- The dismal assessment of the future of population growth and agricultural production of Thomas Malthus (1798),
- John Muir’s 19th-century preservationist vision (Muir 1997),
- The utilitarian preferred future of Gifford Pinchot (1947),
- The biologically impoverished dystopia of Rachel Carson’s *Silent Spring* (1962),
- Julian Simon’s cornucopian dream of limitless natural resources (Simon 1981), and
- The Club of Rome’s models of resource depletion and limits to growth (Meadows et al. 1972).

Whether you agree or disagree with these visions of the environmental future, their influence has been felt for generations. But these legacy futures may not reflect our relationship with nature today, let alone the many possibilities for a significantly different future relationship with nature in a rapidly changing world.

In addition to legacy futures, our thinking about the future is often saddled with views of the future as frozen in the “permanent present,” in part due to our brain’s hard-wiring, which makes it difficult to imagine real change (Sommers 2012). As the renowned economist John Maynard Keynes (1937: 13) said: “[T]he idea of the future being different from the present is so repugnant ... that we, most of us, offer a great resistance to acting on it in practice.” Peck (2009) asserts that one of the most important challenges we face is to open people’s minds to the idea that the present and the recent past may not largely define the future.

Lacking formal training in thinking about the future, being immersed in outdated images, and being stuck in the permanent present, we acquire ideas and intuitions about the future in a haphazard way and end up with defective mental maps of the future. These maps are limited and often counterproductive. Many individuals and organizations rely on narrow, idiosyncratic, and backward-looking views of the future. Common but unhelpful ways of thinking include seeing the future as predictable, a dice game, scary and unknowable, unchanging, or predetermined. These modes of thought are inadequate for the complex and changing world we live in today. Environmental decisionmakers require high-quality foresight to successfully deal with the growing pace and complexity of change. Lum (2016: vii) defines foresight as “insight into how and why the future will be different from today.” Developing robust foresight requires a type of critical thinking that is the focus of this paper.

This paper reviews and synthesizes core principles for thinking about the future and related strategies for developing environmental foresight. These principles and strategies are drawn from the transdisciplinary field of futures studies (Bengston et al. 2012, Cook et al. 2014) and the large body of work of academic and consulting futurists. The principles distill what leading

futurists have learned through decades of study from a variety of disciplinary perspectives and theoretical frameworks. For more than 50 years, futurists and allied scholars in other disciplines have thought deeply and creatively about the nature of the future, developed many insights about change that shapes the future, and created practical strategies and methods for developing useful foresight.

The following sections outline 10 principles for thinking about the future along with a set of strategies to apply each principle to planning and decisionmaking. This is

not a comprehensive review, but it is based on a wide reading and synthesis of the futures research literature. There is some overlap in the strategies presented because many are applicable to more than one principle. There is also a degree of paradox in some of the principles because the future often unfolds on multiple paths that contain paradox and contradiction (May 1996). Taken together, the principles and strategies described here can help guide environmental planners, managers, and policy makers toward well-considered expectations for the future.

“It is important that the future be seen as a number of possible alternatives. Futures, not future.”

~ Eleonora Masini (1993b: 8)

1. THE FUTURE IS PLURAL

The Principle

A core principle for thinking about the future is that it is plural: Rather than a single future, there are countless possible alternative futures (Dator 2002, de Jouvenel 1967, Masini 1993b). The idea of plural futures is a widely held belief about the nature of the future among futurists, but plural futures are foreign to our normal pattern of speaking and thinking (May 2002). In everyday English usage we refer to “the future” as if it is singular; futurists often talk about “the futures” (Dator 2002).

Bishop (1998) maintains that viewing the future as plural is superior for understanding and preparing for the long-term future because single, clear predictions give a false sense of certainty. “Futurists believe that basing a decision on a single prediction is like putting all your eggs in one basket” (Bishop 1998: 40). The goal of futures thinking is to help decisionmakers prepare for a range of plausible futures, rather than the impossible task of making accurate long-term predictions. There is no way to definitively prove that the future is plural, but the multiplicity of possible futures is apparent in eminent historians’ counterfactual histories, which reveal how dramatically differently events could have unfolded and that nothing in the past was inevitable (Cowley 2001, Ferguson 2000).

There are many alternatives to the plural view of the future. For example, a cyclical view was common among ancient cultures, in which future events are fixed and determined with no substantive change, repeating in an endless circle (Staley 2007). Another “single future” belief widely held in Western societies is the view that events are progressive —the future will inevitably be better than the past and present. This belief about the future was central to early Christian culture, other religious traditions, the Enlightenment and Scientific Revolution, and Marxist views, and today is held by many technological optimists and utopian thinkers.

Another alternative to the plural view of the future comes from science. The prevailing view in science

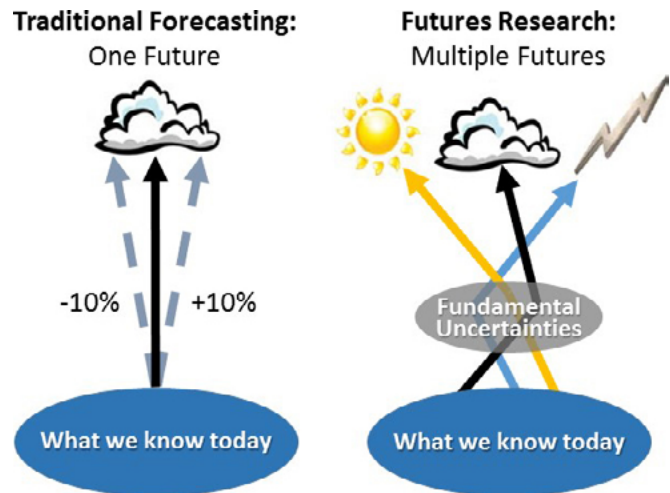


Figure 1.—Traditional forecasting (one future) compared to futures research (multiple futures). Adapted from Weeks et al. (2011).

has been of a predictable, single future. Traditional forecasting focuses on extrapolating past data to predict a single future, usually with a sensitivity analysis in an attempt to account for uncertainty in key variables (Fig. 1). In contrast, futures research recognizes fundamental uncertainties in key drivers of change and the presence of “unknown unknowns” (Ilmola and Rovenskaya 2016), and explores a much wider range of alternative futures.

Foresight Strategies

Adopting the premise of plural futures has many implications for strategies to improve environmental foresight, including the need for multiple 1) attitudes toward or perspectives on the future, 2) theories of change, and 3) methods to explore possible futures. As Inayatullah (1996: 509) notes, it is essential to maintain a “biodiversity of thought” about the future.

First, if there are many possible futures, there is no one correct attitude toward it—multiple attitudes and perspectives are needed. To get a more complete picture of the full range of possible futures, futurists frequently recommend adopting multiple attitudinal lenses, such as optimistic, pessimistic, status quo, and transformational perspectives (Bishop 1998, May 2002, Schwartz 1996). In another approach to multiple

perspectives, Linstone (1981, 2010) has argued that organizational/societal, personal/individual, and technical perspectives should be adopted to provide greater insight into technology assessment and other futures contexts. If we cling to one attitude, such as technological optimism or doom-and-gloom pessimism, we limit our thinking to a single possibility or narrow range of similar possibilities.

Second, gaining insight into plural futures requires multiple theories of change. Diverse theories of change drawn from different fields of study help generate foresight and aid in the exploration of a wider range of possibilities. For example, Peck (2009) reviews theories of change from many disciplines with relevance for studying the futures, including theories from physics, complexity sciences, biology, and various schools of psychology. According to Peck (2009: 108), some possible futures “may only be comprehensible or apprehensible through the lenses of many very different theories.” Noble (2000) reviews theories of social change from Adam Smith to postmodernism, none of which, he posits, has a monopoly on validity.

Finally, gaining insight into plural futures calls for the use of multiple methods. Every method has limitations and multiple methods are needed to shed light on different aspects of plural futures (Bell 1997, Day and Schoemaker 2006). Since the work of pioneering futurists at RAND Corp. in the 1950s (Rejeski and Olson 2006), futurists have developed and adapted scores of methods, which range from:

- expert-based (e.g., Delphi, foresight panels) to participatory methods involving diverse stakeholders (e.g., futures wheels, scenario workshops),
- evidence-based (e.g., horizon scanning, modeling) to methods that emphasize creativity and imagination (e.g., wild-card brainstorming, visioning), and

- quantitative (e.g., cross-impact analysis, quantitative scenarios) to qualitative (e.g., causal layered analysis, qualitative scenarios).

All comprehensive approaches to futures research utilize multiple methods to strengthen foresight and the robustness of findings, such as Voros (2003), Hines and Bishop (2013), Dator (2009), and Lum (2016).

The efficacy of strategies that use multiple attitudes, theories, and methods to help understand plural futures has been shown by research in political science, cognitive psychology, and behavioral economics (Gardner 2012, Tetlock 2005). For example, political scientist Philip Tetlock’s long-term study of 82,000 predictions by 284 experts found that the experts were only slightly better than random guesses, regardless of their educational level, years of experience, or disciplinary background. The one factor that distinguished significantly better predictions was whether the experts were classified as “hedgehogs” or “foxes,” after philosopher Isaiah Berlin’s (1978) essay “The Hedgehog and the Fox.” Experts who had a single narrow and inflexible worldview and strong ideological convictions (hedgehogs) were significantly poorer prognosticators than those with flexible worldviews, a pragmatic approach, and the ability to see more complexity and nuance (foxes). Hedgehogs know one thing (e.g., a single overarching theory of how the world works, or how the economy works), but foxes know many things (i.e., they are generalists with broad knowledge and many perspectives and theories). Futurists, like foxes, tend to be generalists (Bell 1997), and natural resource professionals need to be foxes when thinking about the future.

“Futurists use the concept of alternative futures to understand how change might play out in the future.”

~ Peter Bishop and Andy Hines (2012: 39)

2. THE FUTURE IS POSSIBLE, PLAUSIBLE, PROBABLE, AND PREFERABLE

The Principle

Futurists often distinguish four separate but interrelated types of alternative futures: possible, plausible, probable, and preferable, for example, Henchey (1978), Hines and Bishop (2006), and Masini (1993b) (note that some, such as Amara [1981], Bell [1997], and Toffler [1978], distinguish three types—possible, probable, and preferable). Considering all four types of futures yields a more comprehensive and insightful forward view. Possible futures are by far the largest and broadest class of alternative futures because the realm of possibilities is vast (Fig. 2). This category includes futures which seem highly unlikely or “far out” because they may involve technology that does not currently exist or extremely low probability events. Possible futures may go beyond the bounds of plausibility. Futurists are reluctant to reject implausible ideas out of hand because “[t]he world is ... full of things that intelligent and well-educated people at one time believed to be impossible” (Bell 1997: 78). “Wild cards” are a type of possible future that have low probability but high impact if they were to occur (Petersen 1997). Examples of possible wild cards are abrupt climate change (Lenton et al. 2008), a massive solar flare that causes long-term disruption of global electronics and communications (Riley 2012), and rapid advancement of nanotechnology (Drexler 2013). Events such as these have low probability but would have massive impacts.

Plausible futures are a small subset of possible futures but are still a relatively large category. They encompass futures which most people would consider believable and are consistent with our current understanding of science, technology, and social and economic systems. Hines and Bishop (2006: 128) characterize plausible futures as having “a discernable pathway from the present to the future.”

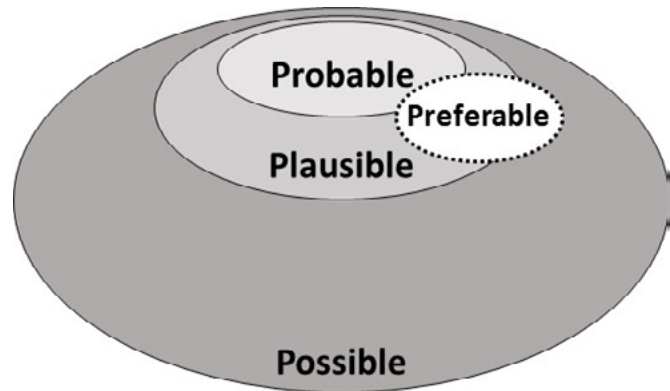


Figure 2.—Four types of futures. Adapted from Bishop and Hines (2012).

Probable futures are a subset of plausible futures that are considered reasonably likely to happen. The probable future considered “most likely” is based on a continuation of current trends and is often called the business-as-usual, baseline, or “official” future. Traditional forecasting focuses on the business-as-usual future based on past trend data. Of course, current trends may not continue and therefore an extrapolation of current trends may be a poor indicator of where we are headed. Marcus (2009) notes that trends are about the past and it is more important to ask what critical factors could move trends in different directions. Futurist Herman Kahn (1982: 82) succinctly stated, “The most likely future isn’t.” In other words, even what is considered to be the most likely future may actually have a low probability given the complex nature of social-ecological systems and the frequency of discontinuous change and surprise.

Finally, preferable or preferred futures are of a different nature than possible, plausible, and probable futures, although they can overlap with any of these three categories as illustrated in Figure 2. Preferable futures are concerned with what we individually or collectively want to happen in the future. They are explicitly subjective and derive from value judgments. Preferable futures for an organization or community are often developed through a visioning or preferred futuring process, such as Lippitt (1998), Hicks (1996), Hines and Bishop (2006), and Ziegler (1991).

Foresight Strategies

The possible, plausible, probable, and preferable typology involves a much wider range of alternative futures than most of us are used to thinking about, especially the broad scope of possible and plausible futures, which can include wild cards. Three strategies to expand futures thinking are briefly discussed next: 1) scanning broadly, 2) the use of techniques to enhance creativity and imagination, and 3) participatory methods that incorporate diverse ideas and perspectives.

Horizon scanning is a core futures method that aims to identify and interpret the meaning of emerging issues and weak signals of change that could shape the future (Bengston 2013, Day and Schoemaker 2006). Scanning broadly for future possibilities requires exposure to diverse information and ideas. Schwartz (1996) suggests scanning nontraditional sources and seeking out potential trends on the edges of society rather than the mainstream. Some professional scanners recommend including speculative fiction, poetry, film, music, and art to develop an awareness of deeper cultural currents and changes in society (Coote 2012). The future often appears first on the margins (Masini 1993a), so scanning the fringes can be an effective strategy for expanding our beliefs about what is possible and plausible.

Breaking out of a narrow range of alternative futures requires imagination and intuition. Lombardo (2006: 180) states that identifying “possible futures is not simply a logical process—it is visionary, intuitive, and creative.” Creativity is needed to see beyond the constraints of linear change and the expected future (Fobes 1996). A special issue of the *Journal of Futures Studies* focused on “Intuition in Futures Work” (Markley 2015). Futurists use a variety of techniques to stimulate fresh, outside-the-box thinking, for instance, Cornish (2004: 123-124), Michalko (1998, 2000), and Sommers (2012). Examples of these techniques include various forms of brainstorming with diverse groups, examining problems from multiple perspectives, and mind-mapping techniques and software.

Another critical strategy to expand our futures thinking is to engage diverse viewpoints. Diversity has many tangible benefits: Complex problems are often solved better by diverse teams of capable members than by nondiverse teams of experts (Page 2007) and diversity fosters innovation (Østergaard et al. 2011). Participatory futures methods have long been used to incorporate a diversity of viewpoints. Examples include participatory scenario planning, public Delphi, Future Search conferences, the futures wheel, and preferred futuring methods. All of these methods and others, if properly carried out, engage diverse perspectives to explore a wide range of futures.

3. THE FUTURE IS OPEN

The Principle

Futurists frequently assert that “the future is open,” by which they mean it is not fixed and we have opportunities and freedom to influence the future in a positive direction (Bishop 1998, Dator 2002, de Jouvenal 1967, Slaughter 1993). There are physical, biological, and social constraints on what is possible, at least within a certain timeframe, but within the realm of possibility the future is mostly open and our choices and actions can help create it. On his “Open the Future” Web site, environmental futurist Jamais Cascio’s answer to “Why do we think about the future?” is that futurists “think about the future because we believe two fundamental things: 1), that the future matters; and 2), that we still have a say in the future we get. The shape of tomorrow arises from the choices we make today” (Cascio 2015). Cascio further believes that we can create a future that is open in the sense of being democratic, transparent, participatory, and filled with many viable options.

The assumption of an open future offers hope and opportunity: Positive change is possible. The future is a domain of freedom and empowerment because we can choose and act to bring about a desirable future (Bell 1997). If we are not locked into a particular path that will dictate our future, we can explore and pursue alternatives. As Slaughter (1993) observed, the openness of the future is what makes it worth studying. Open futures are a critical dimension of thinking about the future because of the powerful role of images of the future in shaping behavior (Costanza and Kubiszewski 2014, Polak 1973). The idea of open futures is closely related to preferred futures, discussed in the preceding section.

Foresight Strategies

Visioning is an essential strategy related to the principle that the future is open. A core method in futures research, visioning is a vital step in most comprehensive futures projects (Hines and Bishop 2006). Visioning

typically involves a participatory process for envisioning a preferred future, that is, a compelling statement that a group or organization wants to create based on shared deep values and purpose (Bezold 2009c). According to Lippitt (1998), shared visions of the future should entail several components: clarity, shared understanding, specific imagery, strategic orientation, and group buy-in. Images of preferred futures are significant because they enhance options and possibilities in the present (Slaughter 1995). Costanza (2000: 1) expressed the importance of a positive vision of our environmental future: “The most critical task facing humanity today is the creation of a shared vision of a sustainable and desirable society.”

There are many approaches to visioning, going back to the early years of futures research. For example, “future workshops” to create visions of preferred futures were organized and conducted in Europe by futurist Robert Jungk beginning in 1962 (Jungk and Mullert 1987). The 3-day workshops began with a day of thoroughly critiquing the situation being addressed, followed by a day of brainstorming about possible solutions. The most promising ideas were then selected democratically and small groups developed them into feasible projects. The workshops concluded with an implementation phase in which constraints and obstacles were examined and a plan of action was developed. While Jungk and others were conducting future workshops in Europe, Americans Edward Lindaman and Ronald Lippitt created a similar method called Preferred Futuring. Various forms of Preferred Futuring have been used by tens of thousands of organizations in recent decades (Lippitt 1998).

Many other approaches to visioning have been developed, including Dator’s (2009) preferred futures visioning process and the Institute for Alternative Futures’ aspirational futures method (Bezold 2009a). Bookman (2000) describes one of the few comprehensive examples of visioning applied to an environmental concern: an effort to develop a shared vision of coastal areas in the United States and a subsequent national dialogue to disseminate the vision.

“Men, forever tempted to lift the veil of the future—with the aid of computers or horoscopes or the intestines of sacrificial animals—have a worse record to show in these ‘sciences’ than in almost any scientific endeavor.”

~ Hannah Arendt (1978: 159)

4. THE FUTURE IS FUZZY

The Principle

Knowledge of the future is always imperfect and severely limited (Cornish 2004). As de Jouvenel (1967), Bell (1997), and others have noted, there are no facts about the future. This seems obvious, and yet large sums of money are spent every year on sophisticated efforts to accurately *predict* the future in finance, business, the environment, and many other fields. Unfortunately, the track record of these efforts has been poor at best (Lipset 1983, Makridakis et al. 2010, Pilkey and Pilkey-Jarvis 2007, Sarewitz et al. 2000, Sherden 1998).

Our ability to accurately predict and our knowledge of the future of complex social-ecological systems are necessarily limited for several reasons. First is the nature of complex systems, including their emergent nature and sensitive dependence on initial conditions (Gleick 1987). Emergent properties of a system cannot be predicted from the parts (de Haan 2006). Sensitive dependence on initial conditions implies that one *may* be able to predict the behavior of a complex or chaotic system with a reasonable degree of accuracy in the short term, but not in the medium or long term. Carpenter (2002) notes that ecological forecasts are filled with irreducible uncertainties due to drivers of change beyond the scope of ecology (e.g., anthropogenic climate change, demographic change), unknown feedbacks in coupled social-ecological systems, and unpredictable human actions.

Second, knowledge of the future is imperfect because human perception is biased in many ways. Hammond et al. (1998) review eight key cognitive biases that affect our decisionmaking and views of the future. For example, recallability bias causes us to give unwarranted weight to recent, dramatic events, and confirmation bias leads us to seek out and accept information supporting our existing views and to discount opposing information. Sommers (2012: ix-x) cites recent neuroscience research suggesting that our brains are hard-wired to not believe or even imagine unfamiliar futures because “the same neural networks we use to

envision the future are also used to recall memories. That means most of us can only imagine what we already know.” We are biologically predisposed to not imagine the possibility of significant change and are often trapped in the “permanent present.”

Finally, even the way we typically talk about the future in Western cultures can trick us into thinking that our knowledge is much more robust than it is. Just as referring to “the future” in the singular is a hindrance to understanding its plural nature, saying that “the future lies ahead” (as if we can see it in our path of vision) and “the past is behind” leads us to believe the future is clear and predictable. Some cultures take the opposite view. For example, traditional Hawaiians believed that we face the past—which we can “see” in our memory—and “the future lies behind” and is out of sight (Dator 2002: 16). In the language of the Tuvans (an ethnic group in Russia), the word for the future is the same as the word for “go back,” and the word for the past is the same as the word for “go forward.” Hence, like native Hawaiian culture, Tuvans believe the past is ahead of them while the future lies behind (Rymer 2012).

Despite our necessarily constrained knowledge of a fuzzy future, imperfect understanding can still provide useful, even invaluable, guidance (Cornish 2004). Foresight does not have to be perfect to help us make better decisions and avoid mistakes. Even limited insight into the future may be the most useful type of knowledge (Bell 1997, de Jouvenel 1967, Lombardo 2006). In the business world, for example, if your foresight is just slightly better than your competitors’, you have a significant strategic and competitive advantage. In natural resource management, fuzzy foresight can be used to strengthen resilience and to develop management strategies that are robust in the face of uncertain alternative futures.

Foresight Strategies

Futurists have developed a wide range of methods, all of which can be thought of as tools to deal with imperfect knowledge about the future. Scenario planning provides useful mental maps of plausible futures rather than the

impossible task of accurate prediction (Staley 2007). Horizon scanning involves identifying and interpreting the meaning of emerging issues and weak signals of change that could shape the future (Bengston 2013). The Delphi method (Gordon 2009) and foresight panels (Bengston and Olson 2015) are ways to elicit expert judgment about possible future developments. Causal layered analysis is a structured approach to look beneath the surface and beyond the level of rational discourse and debate in a futures exercise to the deeper levels of different fundamental beliefs and worldviews, and to the deepest level of myths and mythic metaphors (Inayatullah 1998, 2004). Glenn and Gordon (2009) provide a comprehensive review of these and many other futures research methods.

Beyond the specific methods of futures research, a general strategy to cope with the fuzziness of the future is to take a “learning approach,” that is, to continuously explore the future as it unfolds and as new information becomes available. The idea that futures work needs to be an ongoing process is widespread (Masini 2006; May 1997, 2002; Schwartz 1996). An example of a learning approach is de Jouvenel’s (1967) “surmising forum,” a continuous marketplace of futures thinking in which a wide range of ideas are discussed and critiqued in order to generate images of attainable and preferred futures.

“The most surprising future is one which contains no surprises.”

~ attributed to Herman Kahn

5. THE FUTURE IS SURPRISING

The Principle

Related to the preceding principle of imperfect knowledge or fuzziness is the principle that the future will surprise us. Holling (1986: 294) defined surprise as occurring “when perceived reality departs qualitatively from expectation,” and he characterized surprise as a key concept for understanding interactions between humans and the environment. Although change can be smooth and continuous—a trend line producing an expected future—it is often discontinuous and surprising, and even expected futures tend to arrive in unexpected ways and with surprising consequences (Saffo 2007). Extensive empirical research has shown that people consistently underestimate uncertainty and the possibility of rare events (Makridakis et al. 2010, Tversky and Kahneman 1974). Futurists assert that the most surprising future would be one with no surprises (Cornish 2004). Noting the prevalence of discontinuous change and surprise, Fuerth (2012: 10) observed that “[in] a complex universe... the only certainty is surprise.”

A distinctive aspect of futures thinking is the inclusion of “wild cards,” a type of surprise characterized by low probability and high impacts (Petersen 1997). But there are many types of surprise that characterize and will help shape the future. Toth (2008) reviewed various typologies of surprise and proposed his own three-part typology. First, “anticipatable surprises”—also referred to as “inevitable surprises” (Schwartz 2004) and “predictable surprises” (Watkins and Bazerman 2003)—include known but unexpected events (for example, a 500-year flood) as well as unknown events for which there are precursors or weak signals that could be discerned given a concerted effort to connect the dots (for example, a scientific paradigm shift). Second, “conjecturable surprises” are not preceded by early indications but are plausible in hindsight once they transpire. Although much more difficult to identify in advance, conjecturable surprises nevertheless may be detected by a combination of imagination, expert knowledge, and luck. Finally, “out-of-the-blue surprises” defy detection by even the most creative minds and techniques. A hypothetical example of an out-of-the-blue surprise is when a social or ecological system moves beyond a threshold that was

not previously known or understood and behaves in a new and unforeseen way (Walker and Salt 2006).

Foresight Strategies

Many strategies have been developed for dealing with surprising change. One approach is to systematically search for, assess, and monitor potential surprise, especially wild cards. For example, Markley (2011) described a four-level typology and a related method for monitoring emerging awareness of wild cards and their credibility, and Mendonça et al. (2004) proposed a method based on the type of wild card, the subject area affected (e.g., economic, environmental, technological), and the nature and magnitude of potential impacts. Petersen (1997) maintains that there are always early warnings of impending wild-card events, but we frequently miss them because we tend not to think about such events and the precursors that might signal their approach. By identifying potential positive and negative surprises in advance through regular wild-card brainstorming, early indicators can be identified and monitored and plans to deal with their impacts can be developed.

Another foresight strategy for dealing proactively with surprise is use of the futures wheel method to anticipate surprising consequences of change (Barker and Kenny 2011, Bengston 2016). Significant change produces a cascade of direct and indirect unanticipated consequences. The futures wheel is a “smart group” method that uses a structured brainstorming process to uncover and evaluate multiple levels of surprising consequences of all types of change. The output is a map of possible direct and indirect, positive and negative impacts that can be analyzed to develop strategies to promote desirable consequences and avoid undesirable ones.

Many other strategies have been developed for dealing with surprising futures, including scenario planning to consider a much wider range of possible futures and reduce surprise (Bishop et al. 2007), developing policies to increase adaptive capacity (Bennett et al. 2003, Holling 1978), creating plans that will be resilient to surprises (Makridakis et al. 2010), and taking rare events seriously rather than treating them as outliers to be ignored (Makridakis et al. 2010, Taleb 2010).

6. THE FUTURE IS NOT SURPRISING

The Principle

The frequency and important consequences of surprising change might lead one to think that if we could step 20 or 30 years into the future, it would be an unrecognizable landscape. But in many ways—perhaps most ways—the future will look a lot like today and will not be surprising. As Saffo (2007: 130) has argued, “Even in periods of dramatic, rapid transformation, there are vastly more elements that do not change than new things that emerge.” Harmon (1979) calls this the principle of continuity and points out that over time most aspects of culture and the institutional framework of a society continue without significant change. Dramatic social, technological, and environmental change is fascinating, but the inclination to see sweeping and surprising change emerging everywhere is a great liability for futurists and forecasters. The future contains continuity and change, stasis and flux (Bishop 2012, Lombardo 2006, Millet 2011, Naisbitt 2006, Staley 2007).

Stability-reinforcing, anti-change forces are termed “stabilities” by Lum (2016). Common stabilities include rules, customs, and traditions; physical or logistical constraints that dampen or prevent change; ingrained patterns of behavior; and powerful stakeholders, entrenched leaders, or others who benefit the most from the status quo. Economic factors also frequently reinforce stability, such as a technological innovation that is technically feasible and widely expected to have transformative effects but proves to be too costly and is therefore never adopted (Schnaars 1989).

Another factor promoting stability and continuity is the dynamic of “trend/countertrend,” in which trends often create pressures for their opposite or countertrend (Weiner and Brown 2005). For example:

- Rising prices for a commodity create pressure to conserve the commodity or develop alternatives, which drives prices down.
- Growing secularism in society may eventually produce a countertrend of increasing

spirituality as people seek to fill a void created by an emphasis on the material world.

- The decline in the sense of community in our society (Putnam 1995) may be offset by the countertrend of the rise of new forms of community (Putnam and Feldstein 2004).
- Adoption of a new technology may be slowed or halted by a countertrend of ongoing innovation and advances in the existing technology that was being replaced: “When a competitive technology arrives on the scene, don’t assume that the old technology will roll over and play dead” (Martino 1987: 149).
- A buildup of hazardous biofuels in forests, caused in part by aggressive fire suppression, will eventually result in an increase in the number of large, intense wildfires, eliminating the excessive fuel load (Olson et al. 2015).

Foresight Strategies

An important strategy related to the principle that the future will not be surprising is to include a historical review of the subject area of interest in futures projects, such as Dator (2009), Hines and Bishop (2013), and Marcus (2009). Reviewing history improves our thinking about the future by reminding us of important changes that have occurred in the past and also that “not every expected transformation actually came to pass; some things have remained largely unchanged over history” (Lum 2016: 9). Identifying what has changed and what has remained the same in the past helps us uncover patterns that may drive change in the future.

Another strategy is to include unchanging components known as “predetermined elements” in scenario analysis and other futures methods (Schwartz 1996, Wildlife Conservation Society Futures Group and Bio Economics Research Associates 2007). These are unsurprising constants that seem highly likely to continue no matter which scenario comes to pass. Examples are most demographic change, growing urbanization, economic globalization, and continued loss of biodiversity. Schwartz (1996: 111-112) identifies

four types of predetermined elements to consider: slow-changing phenomena (e.g., the growth of populations), constrained situations (e.g., the need to suppress wildfire in populated areas to protect human life),

change that is “in the pipeline” (e.g., a growing wave of retirements among baby boomers), and inevitable collisions (e.g., higher concentrations of greenhouse gases leading to climate disruption).

“The faster the car, the further the headlights must go.”

~ Gaston Berger (1964)

7. THE FUTURE IS FAST

The Principle

The idea that change is occurring at a rapid and perhaps accelerating pace is widespread in society and among futurists. Alvin Toffler’s classic *Future Shock* describes “the roaring current of change” and the stress and disorientation that individuals and organizations feel when they experience “too much change in too short a time” (1970: 3-4). An acceleration of the rate of change in recent decades has been observed, especially accelerating technological change but also social and environmental change (Colville 2016, McNeill and Engelke 2016). The period following World War II has been termed the “Great Acceleration” (Hibbard et al. 2007), a time of significant increase in the scope, scale, and intensity of many types of change and its impacts on social-ecological systems (Fig. 3). Perhaps it is no coincidence that the post-WWII period also marked the rise of modern futures studies (Kuosa 2011, Rejeski and Olson 2006), as a response to accelerating change.

Some futurists and futures organizations focus on accelerating or exponential change and its powerful potential role in shaping the future. Examples are the Acceleration Studies Foundation (<http://www.accelerating.org/index.html>) and Singularity University (<http://singularityu.org/>). Ray Kurzweil’s “Law of Accelerating Returns” proposes that the rate of change in technology and a wide range of human systems tends to increase exponentially (Kurzweil 2000, 2001). The acceleration in the pace of technical change is due to using our best technology to build the next generation of technology, and the rate of improvement in speed, efficiency, price-performance, and power speeds up from one generation to the next: “The first computers were designed on paper and assembled by hand. Today, they are designed on computer workstations with the computers themselves working out many details of the next generation’s design, and are then produced in fully automated factories with only limited human intervention” (Kurzweil 2005: 40).

An implication of fast and accelerating change is that the future may be approaching much faster than we think. Significant change is possible in a relatively short time. “Almost *anything* can be done in twenty years[.]” according to futurist and systems scientist Earl Joseph (quoted in Cornish [2004: 5]). It took just 4 years to build the first atomic bombs, despite many experts’ insistence that it could not be done. And it took 8 years from President Kennedy’s goal of going to the moon to the Apollo 11 landing. Rapid shifts in social norms, attitudes, and behaviors are also possible, such as the change in attitudes toward smoking and in smoking rates, legal acceptance of gay rights and same-sex marriage in the United States, and possible future shifts in attitudes regarding climate change (Ross et al. 2016).

Rapid change sometimes occurs in a punctuated and discontinuous manner, rather than following a smooth steep or exponential curve—periods of abrupt change separate longer periods of low change or relative stability (Biggs et al. 2016, Lombardo 2006). Alternating periods of slow, continuous change and rapid, discontinuous change form a pattern of punctuated equilibrium, as in the theory of biological evolution (Gould and Eldredge 1972), which can result in regime shifts in social-ecological systems and massive higher order impacts.

Foresight Strategies

Active and continuous horizon scanning is a strategy widely used in the business world and military to stay one step ahead of increasingly rapid change (Bengston 2013). Also called environmental scanning, horizon scanning is a process for finding and interpreting the implications of early indicators of change in the internal and external environments of an organization or field. There are many approaches to horizon scanning, such as Hines (2003), Juech and Michelson (2012), and Slaughter (1999), but the core elements (Hines and Bishop 2006: 69) are:

- Finding: exploring for “scanning hits,” that is, early indicators of change;

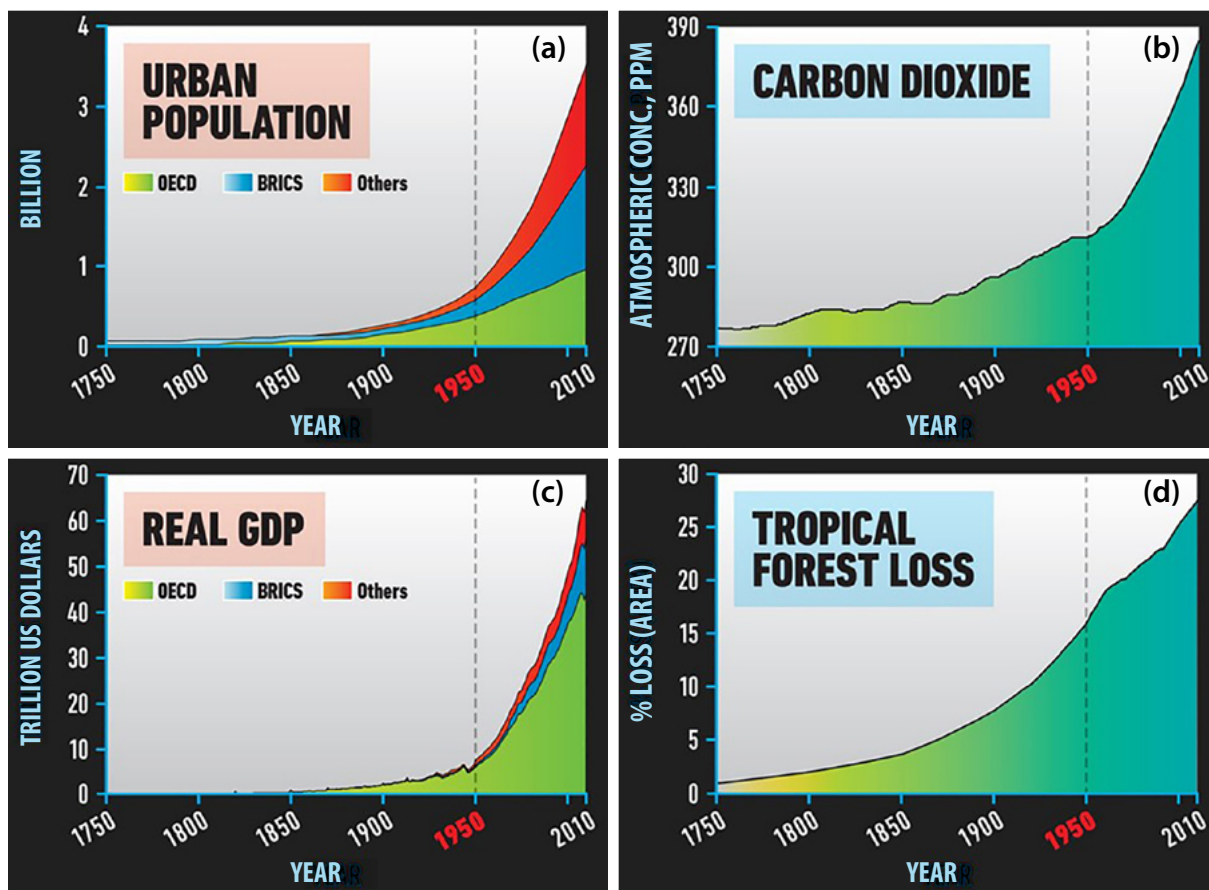


Figure 3.—Four of the "Great Acceleration" graphs, showing a rapid and accelerating pace of change for (a,c) two social-economic indicators in three groups of countries and (b,d) two ecological indicators. Brazil, Russia, India, China, and South Africa are the BRICS economies. Thirty-five other countries are members of the Organisation for Economic Co-operation (OECD). GDP is gross domestic product. Source: Steffen et al. (2015).

- Analyzing: developing insights about what is found;
- Framing: developing a framework for organizing insights; and
- Applying: using the insights in planning and decisionmaking to increase organizational agility and resilience to respond quickly to rapid change.

Another strategy for developing foresight in the context of fast change is a "learning approach" or continuous exploration of a rapidly evolving future (also discussed as a strategy for the fuzziness of the future, Principle 4). Foresight becomes dated due to rapid change and needs to be continuously monitored, evaluated, updated, and revised according to new data and changing conditions.

“People are especially sensitive to changes that occur quickly and are prone to ignore changes that happen slowly.”

~ Robert Olson (2016: 4)

8. THE FUTURE IS SLOW

The Principle

Abrupt and rapid change attracts the most attention, but the future is also powerfully shaped by slow, continuous, incremental change (Bishop 2012, Olson 2016). Examples of slow change having significant cumulative long-term impacts abound:

- Global population has been growing by just 1.18 percent annually and the rate is slowing, but that is enough to increase from 7.3 billion today to 11.2 billion by the end of the century (United Nations Population Division 2015);
- The growth of antimicrobial resistance is slow but over time could seriously threaten public health as the prevention and treatment of a wide range of infections become ineffective (World Health Organization 2015);
- Over the past 20 years, the slow encroachment of development has resulted in the loss of a tenth of global wilderness, representing an area twice the size of Alaska and about half the size of the Amazon (Watson et al. 2016).

Numerous additional examples of gradual change could be cited: aquifer depletion, loss of topsoil, infrastructure decay, and the slow adoption of some major technologies. Perhaps the ultimate example of slow change with massive long-term consequences is climate change, with its effects emerging gradually over many decades—unless we reach a major tipping point and experience abrupt climate change (Lenton et al. 2008). In a discussion of the challenges of mobilizing individual and collective action to deal with climate change, Ross et al. (2016: 363) observed: “When it comes to confronting environmental perils that lie in

the future and unfold gradually, our species generally has failed to exercise *foresight intelligence*—that is, to recognize, diagnose, plan and act to address those perils before it is too late to do so.”

Slow change frequently eludes the public policy attention it deserves for a variety of reasons (Olson 2016). For example, evolutionary psychology has found that our brains evolved to respond best to threats that are imminent and abrupt, making it easy to ignore changes that happen slowly. Our perception of slow change is vulnerable to distortion by a number of cognitive biases, such as social discounting (undervaluing future risk), short-term bias (reluctance to accept short-term costs now to avoid much larger costs in the future), and optimism bias (believing that we face lower risks than others do). Slow change also generally fails to meet the criteria of newsworthiness, making it difficult to attract public and political attention.

Foresight Strategies

Most if not all foresight methods are well-suited for dealing with slow change because they take a long-term view of the future—far longer than the short time horizon of traditional policy analysis and planning—and often explicitly examine possible long-term consequences of current trends and developments, both fast and slow. The time horizon in scenario planning, for example, is often several decades, enough time to observe and explore the future effects of slow change. Olson (2016) maintains that tackling slow problems requires building foresight capacity in organizations and throughout society, and suggests a “permanent engagement” strategy to make slow change more visible, continuously discussed, and acted upon.

“I eventually decided that all of the many images of the future that exist in the world can be grouped into one of four generic piles.”

~ Jim Dator (2009: 6)

9. THE FUTURE IS ARCHETYPAL

The Principle

Neither the past nor the future exists. As Staley (2007: 14) has observed: “Historians do not really study the past, but rather evidence from the past that has survived to the present . . .” Similarly, futurists cannot study the future directly—how do you study something that does not currently exist? “[A] futurist . . . must . . . examine evidence found in the present about the future” (Staley 2007: 14). Therefore, one of the main tasks of futures research is to study people’s images of the future (Bell 1997) because these images help shape actions today and have significant consequences for the future (Ostrom et al. 2002, Polak 1973). The futurist James Dator studied thousands of images of the future from a wide range of sources and found that they consistently fall into four general categories, which he calls the four generic futures: Continue, Collapse, Discipline, and Transformation (Dator 2009). These four archetypal futures each differ from each other in fundamental ways and are not simply variations around a single set of variables or drivers of change.

Continue, or Continued Growth, is an image of the future based on an extrapolation of current trends and expectations. This is the most common of the four archetypes because it is the “official” future of all governments, educational systems, and corporations. Continued *economic* growth is typically the focus of this archetype. There are many examples of expressions of this future which attempt to build a case for the inevitability of continued growth and prosperity, such as Diamandis and Kotler (2012), Kahn (1982), and Ridley (2010).

The second archetypal future is Collapse. Many different factors could cause or contribute to this future, including economic, environmental, agricultural, or moral collapse or decline. Pandemics, warfare, and other external threats could also cause collapse. Most people do not want to consider the Collapse future, although Dator (2009) and others point out that organizations, communities, cultures, nations, and civilizations collapse regularly due to a variety of factors (Diamond 2011, Perlin 1989, Tainter 1990).

Third, the Discipline future is an image of a society that is tightly structured around a set of fundamental ideals that could include environmental, spiritual, religious, political, or cultural values. The rationale for this archetype is that our current system is unsustainable or undesirable, and that we need to dramatically reorganize our social-ecological and economic systems so that they are in line with values and rules that will promote stability and sustainability. Expressions of Discipline futures include Barnosky’s (2014) strategies for avoiding a looming Sixth Mass Extinction, and Dator and Park’s (2012) call for Korea to shift from a consumer society to a “Conserver Society,” drawing on Korean cultural traditions that could facilitate such a transition.

Finally, Transformation is an archetype of the future that is usually “high tech” but could also be of a “high spirit” variety, involving transformation driven by significant shifts in values and culture. In the high-tech version of the Transformation archetype, the power of exponential growth in technology transforms every aspect of life. Rapid development and adoption of disruptive technologies such as artificial intelligence, advanced robotics, nanotechnology, genetic engineering, synthetic biology, and others create a world that may be unrecognizable to us today. Kurzweil’s (2005) *The Singularity is Near: when Humans Transcend Biology* and Drexler’s (2013) *Radical Abundance: how a Revolution in Nanotechnology will Change Civilization* are well-known examples of Transformation futures.

MacDonald (2012) independently validated Dator’s archetypes by analyzing many sets of scenarios developed by futurists and identifying four main archetypes, which he termed Progress, Catastrophe, Reversion, and Transformation, each of which has two variants. Dator emphasizes that each of the four archetypal futures has many variations.

Foresight Strategies

Archetypal images are a useful way to think about the future and can be used to create specific scenarios. Their use in developing scenarios in a foresight project is not meant to constrain the scenarios. Instead, the

archetypes are used to help us break out of the “tyranny of the present” and envision categorically distinct alternative scenarios rather than a narrow range of possibilities or minor variations on the same future.

Many scenario analyses have used some variation of archetypal approaches, such as developing scenarios for an optimistic, pessimistic, present trends extended, and wild-card future (Curry 2012). The aspirational futures scenario method, developed at the Institute

for Alternative Futures, was influenced by Dator’s archetypal thinking (Bezold 2009b). This method includes an expected or most likely future based on extension of present trends, a challenge future that explores “what could go wrong,” a positive “aspirational” future, and a fourth scenario that includes “audacious or stretch goals” and considers an alternative path to a positive future (Bezold 2009a).

10. THE FUTURE IS INBOUND

The Principle

The study of the future is the study of change, and change can be inbound or outbound: “Our personal and organizational futures are shaped by two sets of forces: change that happens to us (from the external world beyond our control, which we call ‘inbound’ change) and change that we create ourselves (based on our decisions and actions, which we call ‘outbound’ change)” (Bishop 2012: 13). Individuals and organizations are often caught off-guard by inbound change because we focus most of our attention on what is occurring within our organization or field. Many of us read multiple magazines, journals, and online newsletters informing us about everything going on within our field, but little or nothing informing us about outside developments and possible inbound change that could help shape the future of our field.

The penchant to focus on things happening within our sphere is understandable. We tend to think about things we are interested in and have some degree of control over. But neglecting careful consideration of developments in the world beyond can make us vulnerable to being blindsided by inbound change:

- Digital outsiders Napster (launched in 1999) followed by Apple® iTunes® (debuted in 2004) transformed the way we share and listen to music and disrupted the music industry with inbound change.
- Few public school administrators in the United States in the early 1990s imagined the competition they would face from “outsiders” such as charter schools, online schools, privately run for-profit schools, and vouchers (Fang 2014).
- Self-driving, autonomous vehicles have the potential to dramatically shift the business models and value chains of dozens of industries including financial services, insurance, infrastructure, public safety, transportation, oil and gas, and of course the automotive industry (Simao 2015, Wayner 2013).

- The cultural trend of a growing disconnect with nature, especially among children, could create a cascade of social, psychological, economic, political, and ecological consequences (Louv 2008, Pergams and Zaradic 2008), including profound effects on natural resource management.
- Virtual reality technology has many applications in tourism as well as the potential to disrupt the global tourism industry (Guttentag 2010).

Foresight Strategies

Thinking about the future in a way that produces useful foresight requires “outside-in” thinking, in other words, paying attention to external changes that could profoundly affect your field or organization in the future (Searce et al. 2004). Outside-in thinking—focusing on inbound change—can help organizations and individuals anticipate and prepare for external change.

A framework for outside-in thinking is shown in Figure 4. The center represents your organization, field, or the specific issue of concern. The middle ring is the immediate working environment and drivers of change, and the outer ring is the broader context and drivers. The broad context is often overlooked in planning, which can lead to both unpleasant surprises and missed opportunities. According to Searce et al. (2004: 13), “outside-in thinking can inspire more open and imaginative thoughts about a range of potential changes and strategies that may not have been visible otherwise.”

Broad horizon scanning that includes social, technological, economic, environmental, and political (STEEP) contexts (Morrison 1992) is one way to promote outside-in thinking. Another widely used scanning classification system features six broad categories with the acronym DEGEST: demography, economy, government, environment, society/culture, and technology (Kotler and Keller 2008). Slaughter (1999), Voros (2001), and Hines (2003) focus on the importance of scanning a broad range of sources and draw on the work of integral philosopher Ken

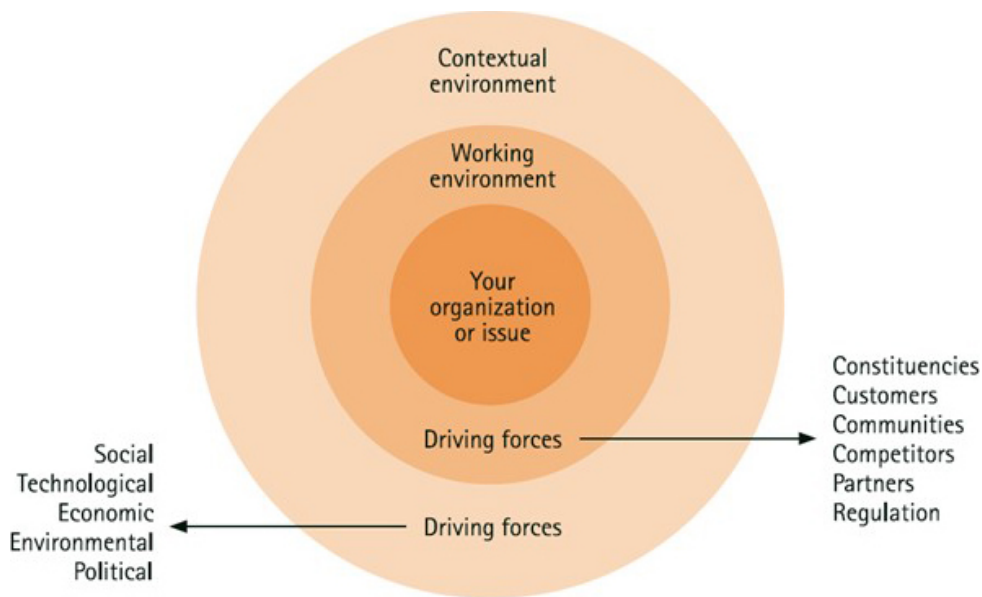


Figure 4.—A framework for outside-in thinking. Source: Searce et al. (2004).

Wilber to achieve this breadth. The essence of this “integral futures” approach is a four-quadrant matrix that identifies four spheres of social life that should be incorporated in scanning to ensure the inclusion of both objective phenomena that are measurable (for example, from the scientific and social realms) and subjective phenomena that must be interpreted (for example, from the realms of art and morality).

CONCLUSIONS

The principles and related foresight strategies outlined in this paper represent the essence of futures thinking and practice. Developed mainly within futures research over more than half a century and presented here in the form of 10 principles, these fundamental precepts provide a structure for insightful thinking about the future. This framework is lacking in our everyday thinking, which is often haphazard and too narrowly focused on a simple continuation of current trends. Systematic futures thinking is also generally lacking among natural resource and environmental professionals and their organizations (Bengston et al. 2012), resulting in a diminished capacity to adapt to accelerating change.

From the 10 principles, a picture emerges of the future as complex and paradoxical:

- The future is plural, like a braided river with many twisting and shifting channels, each

channel a possibility branching out from the present.

- These channels or alternative futures include a wide range of possible futures, a smaller but still large set of plausible futures, a subset of probable futures considered most likely, and preferable futures that define what we desire.
- The future is mostly open rather than fixed, and our choices and actions can influence it in a positive direction.
- Foresight is always imperfect and severely limited, but even limited insight into the future may be the most valuable knowledge (Cornish 2004).
- The future is surprising and unsurprising, composed of both continuity and change. Some futurists believe that continuity dominates, with the vast majority of elements remaining unchanged. Others emphasize the potential for surprising and transformational change.
- The future is fast and slow. Environmental professionals must pay attention to both fast, abrupt change and slow, continuous change. It is important to not “miss the slow train,” as Olson (2016) describes it, by focusing only on rapid change.
- Four archetypal images of the future have been found (Dator 2009). These generic images can help us envision distinct alternative futures

rather than minor variations on the same future, a common shortcoming of traditional forecasting.

- Finally, change that shapes the future can be inbound or outbound. We often neglect inbound change, which can leave us vulnerable to being blindsided.

Futures thinking and exploration must be ongoing and institutionalized into routine planning and policy making to provide lasting benefits. A single foresight exercise quickly loses its value no matter how skillfully done and widely embraced. Institutionalizing foresight capacity can provide many benefits, including helping to: create a longer-term perspective, explore key uncertainties and potential surprises, decrease reaction time to rapid change, anticipate unintended consequences, and shape a preferred future (Olson et al. 2015).

One strategy for institutionalizing foresight is an in-house approach: creating an internal futures unit staffed with several trained futurists, with enough budget and personnel to do high-quality and continuing foresight. This unit would be responsible for regular horizon scanning and high-priority projects exploring possible, plausible, and preferable futures using a variety of foresight methods. A growing number of federal agencies and all branches of the U.S. military have in-house foresight units.

An alternative strategy is to have one person assigned specifically to contract with futures research organizations and think tanks, purchasing scans and futures surveys on a regular basis, and working closely with planners, managers, and policy makers to incorporate the findings into planning and strategies. Outsourcing foresight activities is a common approach in corporations, but it is important to ensure that foresight developed by outside consultants is relevant and incorporated into strategic planning and decisionmaking (Day and Schoemaker 2005). A hybrid approach to institutionalizing foresight, involving both a small in-house futures unit and regular use of outside experts, is often most effective. In-house foresight champions know the culture and the ways of the organization or field, and outside experts bring new ideas and perspectives.

The 10 principles described in this paper can help environmental and natural resource professionals think more deeply and productively about the future. The strategies related to the principles—briefly sketched out in this paper—can help us develop practical foresight, or “insight into how and why the future will be different than today” (Lum 2016: vii). The need for environmental foresight has never been greater in light of the increasing pace and complexity of change with the potential for sweeping environmental and social effects.

LITERATURE CITED

- Amara, R. 1981. **The futures field: searching for definitions and boundaries.** *The Futurist*. 15(1): 25-29.
- Arendt, H. 1978. **The life of the mind. Vol. 2: Willing.** New York, NY: Harcourt Brace Jovanovich. 277 p.
- Barker, J.A.; Kenny, C.G. 2011. **Leading in uncertain times.** *Innovation*. 9(2). April/May.
- Barnosky, A. 2014. **Dodging extinction: power, food, money, and the future of life on Earth.** Berkeley, CA: University of California Press. 256 p.
- Bell, W. 1997. **Foundations of futures studies. Vol. 1: History, purposes, and knowledge.** New Brunswick, NJ: Transaction Publishers.
- Bell, W. 2002. **Making people responsible: the possible, the probable, and the preferable.** In: Dator, J.A., ed. *Advancing futures: futures studies in higher education*. Chapter 1. Westport, CT: Praeger: 33-52.
- Bengston, D.N. 2013. **Horizon scanning for environmental foresight: a review of issues and approaches.** Gen. Tech. Rep. NRS-121. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 20 p. <https://doi.org/10.2737/NRS-GTR-121>.
- Bengston, D.N. 2016. **The futures wheel: a method for exploring the implications of social-ecological change.** *Society and Natural Resources*. 29(3): 374-379. <https://doi.org/10.1080/08941920.2015.1054980>.
- Bengston, D.N.; Kubick, G.H.; Bishop, P.C. 2012. **Strengthening environmental foresight: potential contributions of futures research.** *Ecology and Society*. 17(2): article 10. <https://doi.org/10.5751/es-04794-170210>.
- Bengston, D.N.; Olson, R.L. 2015. **Asynchronous online foresight panels: the case of wildfire management.** *Journal of Futures Studies*. 19(4): 1-12. Available at <https://www.fs.usda.gov/treearch/pubs/48582>.
- Bennett, E.M.; Carpenter, S.R.; Peterson, G.D.; Cumming, G.S.; Zurek, M.; Pingali, P. 2003. **Why global scenarios need ecology.** *Frontiers in Ecology and the Environment*. 1(6): 322-329. [https://doi.org/10.1890/1540-9295\(2003\)001\[0322:WGSNE\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2003)001[0322:WGSNE]2.0.CO;2).
- Berger, G. 1957. **Social science and forecasting.** In: Cournand, A.; Lévy, M., eds. *Shaping the future: Gaston Berger and the concept of prospective*. London, UK and New York, NY: Gordon and Breach: 11-19.
- Berger, G. 1964. **Phénoménologie du temps et prospective [Phenomenology of time and perspective]**. Paris, France: Presses Universitaires de France. 278 p.
- Berlin, I. 1978. **The hedgehog and the fox: an essay on Tolstoy's view of history.** Hardy, H., ed. With a new foreword by M. Ignatieff. 2013. Princeton, NJ: Princeton University Press.
- Bezold, C. 2009a. **Aspirational futures.** *Journal of Futures Studies*. 13: 81-90. <http://jfsdigital.org/wp-content/uploads/2014/01/134-AE06.pdf>.
- Bezold, C. 2009b. **Jim Dator's alternative futures and the path to IAF's aspirational futures.** *Journal of Futures Studies*. 14(2): 123-134. <http://www.jfs.tku.edu.tw/14-2/E01.pdf>.
- Bezold, C. 2009c. **Using vision in futures planning.** In: Glenn, J.C.; Gordon, T.J., eds. *Futures research methodology—ver. 3.0*. [CD-ROM]. Washington, DC: The Millennium Project.
- Biggs, R.; Boonstra, W.J.; Peterson, G.; Schlüter, M. 2016. **The domestication of fire as a social-ecological regime shift.** *PAGES (Past Global Changes) Magazine*. 24(1): 22-23. <https://doi.org/10.22498/pages.24.1.22>.
- Bishop, P. 1998. **Thinking like a futurist.** *The Futurist*. 32(5): 39-42.
- Bishop, P.C. 2012. **An approach to the future.** In: Bengston, D.N., comp. *Environmental futures research: experiences, approaches, and opportunities*. Gen. Tech. Rep. NRS-P-107. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 13-17.
- Bishop, P.C.; Hines, A. 2012. **Teaching about the future.** New York, NY: Palgrave Macmillan. 304 p.

- Bishop, P.; Hines, A.; Collins, T. 2007. **The current state of scenario development: an overview of techniques.** Foresight. 9(1): 5-25. <https://doi.org/10.1108/14636680710727516>.
- Bookman, C.S. 2000. **Town meeting on America's coastal future: using the Internet to promote coastal stewardship.** Ocean & Coastal Management. 43: 937-951. [https://doi.org/10.1016/S0964-5691\(00\)00065-X](https://doi.org/10.1016/S0964-5691(00)00065-X).
- Boulding, K. 1973. **Foreword.** In: Polak, F. The image of the future. Translated and abridged by E. Boulding. San Francisco, CA: Jossey-Bass/Elsevier: v-vi.
- Carpenter, S.R. 2002. **Ecological futures: building an ecology of the long now.** Ecology. 83(8): 2069-2083.
- Carson, R. 1962. **Silent spring.** New York, NY: Fawcett Crest.
- Cascio, J. 2012. **The future teller.** Momentum (University of Minnesota, Institute on the Environment). Fall 2012: 2-3. <http://ensia.com/interviews/the-future-teller/>.
- Cascio, J. 2015. **A world in which.** Full text of a talk given by Cascio on October 21, 2015. Open the future: anticipatory mythologies [blog]. Posted October 22, 2015. http://www.openthefuture.com/2015/10/a_world_in_which.html#more (accessed September 7, 2017).
- Colville, R. 2016. **The great acceleration: how the world is getting faster, faster.** New York, NY: Bloomsbury. 400 p.
- Commonwealth Scientific and Industrial Research Organisation. 2012. **Our future world: global megatrends.** September 5, 2012. http://www.csiro.au/news/transcripts/YouTubeTranscripts/2012/Sep/Our_Future_World.html.
- Cook, C.N.; Inayatullah, S.; Burgman, M.A.; Sutherland, W.J.; Wintle, B.A. 2014. **Strategic foresight: how planning for the unpredictable can improve environmental decision-making.** Trends in Ecology & Evolution. 29(9): 531-541.
- Coote, J. 2012. **A simple guide to futurewatching.** Journal of Futures Studies. 16(3): 107-112. <http://jfsdigital.org/wp-content/uploads/2013/10/163-E02.pdf>.
- Cornish, E. 2004. **Futuring: the exploration of the future.** Bethesda, MD: World Future Society. 313 p.
- Costanza, R. 2000. **Visions of alternative (unpredictable) futures and their use in policy analysis.** Conservation Ecology. 4(1): 5. <https://doi.org/10.5751/es-00171-040105>.
- Costanza, R.; Kubiszewski, I., eds. 2014. **Creating a sustainable and desirable future: insights from 45 global thought leaders.** Hackensack, NJ: World Scientific. 396 p.
- Cowley, R., ed. 2001. **The collected what if? Eminent historians imagine what might have been.** New York, NY: Putnam. 827 p.
- Curry, A., ed. 2012. **The future of futures.** Houston, TX: The Association of Professional Futurists.
- Dator, J.A. 2002. **Introduction: The future lies behind—thirty years of teaching futures studies.** In: Dator, J.A., ed. Advancing futures: futures studies in higher education. Westport, CT: Praeger: 1-30.
- Dator, J. 2009. **Alternative futures at the Manoa School.** Journal of Futures Studies. 14(2): 1-18. <http://www.jfs.tku.edu.tw/14-2/A01>.
- Dator, J.; Park, S. 2012. **Korea as a conserver society.** Social Business. 2(3): 181-204. <https://doi.org/10.1362/2044440812x13469450947436>.
- Dator, J.A.; Sweeney, J.A.; Yee, A.M. 2014. **Mutative media: communication technologies and power relations in the past, present, and futures.** New York, NY: Springer. 199 p.
- Day, G.S.; Schoemaker, P.J.H. 2005. **Scanning the periphery.** Harvard Business Review. 83(11): 135-148.
- Day, G.S.; Schoemaker, P.J.H. 2006. **Peripheral vision: detecting the weak signals that will make or break your company.** Boston, MA: Harvard Business School Press. 248 p.
- de Haan, J. 2006. **How emergence arises.** Ecological Complexity. 3(4): 293-301. <https://doi.org/10.1016/j.ecocom.2007.02.003>.

- de Jouvenel, B. 1967. **The art of conjecture**. New York, NY: Basic Books. 307 p.
- Diamandis, P.; Kotler, S. 2012. **Abundance: The future is better than you think**. New York, NY: Free Press. 386 p.
- Diamond, J. 2011. **Collapse: how societies choose to fail or succeed**. Rev. ed. New York, NY: Penguin Books. 608 p.
- Drexler, K. E. 2013. **Radical abundance: how a revolution in nanotechnology will change civilization**. New York, NY: Public Affairs. 340 p.
- Fang, L. 2014. **Venture capitalists are posed to 'disrupt' everything about the education market**. The Nation. September 25, 2014. <https://www.thenation.com/article/venture-capitalists-are-poised-disrupt-everything-about-education-market/>.
- Ferguson, N., ed. 2000. **Virtual history: alternatives and counterfactuals**. New ed. New York, NY: Basic Books. 560 p.
- Fobes, R. 1996. **Creative problem solving: a way to forecast and create a better future**. The Futurist. 30(1): 19-22.
- Fuerth, L.S. 2012. **Anticipatory governance: practical upgrades**. With E.M.H. Faber. 82 p. http://www.wilsoncenter.org/sites/default/files/Anticipatory_Governance_Practical_Upgrades.pdf.
- Gardner, Dan. 2012. **Future babble: why pundits are hedgehogs and foxes know best**. New York, NY: Plume–Penguin Books. 320 p.
- Gleick, J. 1987. **Chaos: making a new science**. New York, NY: Viking. 352 p.
- Glenn, J.C.; Gordon, T.J., eds. 2009. **Futures research methodology—ver. 3.0**. [CD-ROM]. Washington, DC: The Millennium Project. <http://www.millennium-project.org/millennium/FRM-V3.html#toc>.
- Gordon, T.J. 2009. **The Delphi method**. In: Glenn, J.C.; Gordon, T.J., eds. **Futures research methodology—ver. 3.0**. [CD-ROM]. Washington, DC: The Millennium Project.
- Gould, S.J.; Eldredge, N. 1977. **Punctuated equilibria: the tempo and mode of evolution reconsidered**. Paleobiology. 3(2): 115-151. <https://doi.org/10.1017/s0094837300005224>.
- Guttentag, D.A. 2010. **Virtual reality: applications and implications for tourism**. Tourism Management. 31(5): 637-665. <https://doi.org/10.1016/j.tourman.2009.07.003>.
- Hammond, J.S.; Keeney, R.L.; Raiffa, H. 1998. **The hidden traps in decision making**. Harvard Business Review. 76(5): 47-58.
- Harman, W.W. 1979. **An incomplete guide to the future**. New York, NY: W.W. Norton & Co. 160 p.
- Henchey, N. 1978. **Making sense of futures studies**. Alternatives. 7: 24-29.
- Hibbard, K.A.; Crutzen, P.J.; Lambin, E.F.; Liverman, D.M.; Mantua, N.J.; McNeil, J.R.; Messerli, B.; Steffen, W. 2007. **Group report: decadal-scale interactions of humans and the environment**. In: Costanza, R.; Graumlich, L.J.; Steffen, W., eds. **Sustainability or collapse? An integrated history and future of people on Earth**. Cambridge, MA: MIT Press: 341-375.
- Hicks, D. 1996. **Envisioning the future: the challenge for environmental educators**. Environmental Education Research. 2(1): 101-108. <https://doi.org/10.1080/1350462960020109>.
- Hines, A. 2003. **Applying integral futures to environmental scanning**. Futures Research Quarterly. 19(4): 49-62.
- Hines, A.; Bishop, P., eds. 2006. **Thinking about the future: guidelines for strategic foresight**. Washington, DC: Social Technologies. 242 p.
- Hines, A.; Bishop, P.C. 2013. **Framework foresight: exploring futures the Houston way**. Futures. 51: 31-49. <https://doi.org/10.1016/j.futures.2013.05.002>.
- Holling, C.S. 1978. **Adaptive environmental assessment and management**. IIASA International Series on Applied Systems Analysis. New York, NY: John Wiley & Sons. 377 p.

- Holling, C.S. 1986. **The resilience of terrestrial ecosystems; local surprise and global change.** In: Clark, W.C.; Munn, R.E., eds. Sustainable development of the biosphere. Cambridge, UK: Cambridge University Press: 292-317.
- Ilmola, L.; Rovenskaya, E. 2016. **Three experiments: the exploration of unknown unknowns in foresight.** Technological Forecasting and Social Change. 106: 85-100. <https://doi.org/10.1016/j.techfore.2015.12.015>.
- Inayatullah, S. 1996. **What futurists think: stories, methods and visions of the future.** Futures. 28(6/7): 509-517. [https://doi.org/10.1016/0016-3287\(96\)84430-2](https://doi.org/10.1016/0016-3287(96)84430-2).
- Inayatullah, S. 1998. **Causal layered analysis: poststructuralism as method.** Futures. 30(8): 815-829. [https://doi.org/10.1016/s0016-3287\(98\)00086-x](https://doi.org/10.1016/s0016-3287(98)00086-x).
- Inayatullah, S., ed. 2004. **The causal layered analysis reader.** Taipei, Taiwan: Tamkang University Press. 576 p.
- Inayatullah, S. 2008. **Six pillars: futures thinking for transforming.** Foresight. 10(1): 4-21. <https://doi.org/10.1108/14636680810855991>.
- Juech, C.; Michelson, E.S. 2012. **Innovation in horizon scanning for the social sector: an introduction to the Searchlight function.** Foresight. 14(6): 439-449. <https://doi.org/10.1108/14636681211284908>.
- Jungk, R.; Mullert, N. 1987. **Future workshops: how to create desirable futures.** London, UK: Institute for Social Inventions. 126 p.
- Kahn, H. 1982. **The coming boom: economic, political and social.** New York, NY: Simon and Schuster. 240 p.
- Keynes, J.M. 1937. **Some economic consequences of a declining population.** The Eugenics Review. 29(1): 13-17. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2985686/?page=1>.
- Kotler, P.; Keller, K.L. 2008. **Marketing management.** 13th ed. Upper Saddle River, NJ: Prentice Hall. 816 p.
- Kuosa, T. 2011. **Evolution of futures studies.** Futures. 43(3): 327-336. <https://doi.org/10.1016/j.futures.2010.04.001>.
- Kurzweil, R. 2000. **The age of spiritual machines: when computers exceed human intelligence.** New York, NY: Penguin. 400 p.
- Kurzweil, R. 2001. **The law of accelerating returns.** March 7, 2001. <http://www.kurzweilai.net/the-law-of-accelerating-returns>.
- Kurzweil, R. 2005. **The singularity is near: when humans transcend biology.** New York, NY: Penguin. 672 p.
- Lenton, T.M.; Held, H.; Kriegler, E.; Hall, J.W.; Lucht, W.; Rahmstorf, S.; Schellnhuber, H.J. 2008. **Tipping elements in the Earth's climate system.** Proceedings of the National Academy of Sciences. 105(6): 1786-1793. <https://doi.org/10.1073/pnas.0705414105>.
- Linstone, H.A. 2010. **Multiple perspectives redux.** Technological Forecasting and Social Change. 77(4): 696-698. <https://doi.org/10.1016/j.techfore.2010.02.009>.
- Linstone, H.A.; Meltsner, A.J.; Adelson, M.; Mysior, A.; Umbdenstock, L.; Clary, B.; Wagner, D.; Shuman, J. 1981. **The multiple perspective concept: with applications to technology assessment and other decision areas.** Technological Forecasting and Social Change. 20(4): 275-325. [https://doi.org/10.1016/0040-1625\(81\)90062-7](https://doi.org/10.1016/0040-1625(81)90062-7).
- Lippitt, L.L. 1998. **Preferred futuring: Envision the future you want and unleash the energy to get there.** San Francisco, CA: Berrett-Koehler Publishers. 230 p.
- Lipset, S.M. 1983. **On the limits of social science.** In: Smith, R.B., ed. An introduction to social research: volume I of handbook of social science methods. Cambridge, MA: Ballinger: 149-168.
- Lombardo, T. 2006. **Contemporary futurist thought.** Bloomington, IN: AuthorHouse. 427 p.
- Louv, R. 2008. **Last child in the woods: saving our children from nature-deficit disorder.** Chapel Hill, NC: Algonquin Books. 416 p.
- Lum, R.A.K. 2016. **4 Steps to the future: a quick and clean guide to creating foresight.** Honolulu, HI: FutureScribe. 79 p.

- MacDonald, N. 2012. **Futures and culture.** Futures. 44(4): 277-291. <https://doi.org/10.1016/j.futures.2011.10.011>.
- Makridakis, S.; Hogarth, R.M.; Gaba, A. 2010. **Why forecasts fail: what to do instead.** MIT Sloan Management Review. 51(2): 83-90.
- Malthus, T.R. 1798. **An essay on the principle of population.** Oxford World's Classics, 1st edition. Oxford, UK: Oxford University Press. 208 p.
- Marcus, A. 2009. **Strategic foresight: a new look at scenarios.** New York, NY: Palgrave MacMillan. 209 p.
- Markley, O. 2011. **A new methodology for anticipating STEEP surprises.** Technological Forecasting and Social Change. 78(6): 1079-1097. <https://doi.org/10.1016/j.techfore.2011.01.008>.
- Markley, O. 2015. **Introduction to the symposium on 'Intuition in Futures Work.'** Journal of Futures Studies. 20(1): 83-90. http://www.jfs.tku.edu.tw/?page_id=5520.
- Martino, J.P. 1987. **The gods of the copybook headings: a caution to forecasters.** In: Marien, M.; Jennings, L., eds. What I have learned: thinking about the future then and now. Chapter 13. New York, NY: Greenwood Press: 143-152.
- Masini, E.B. 1993a. **The future on the margins.** Futures. 25(3): 353. [https://doi.org/10.1016/0016-3287\(93\)90145-j](https://doi.org/10.1016/0016-3287(93)90145-j).
- Masini, E.B. 1993b. **Why futures studies?** London, UK: Grey Seals Books. 144 p.
- Masini, E.B. 2006. **Rethinking futures studies.** Futures. 38(10): 1158-1168. <https://doi.org/10.1016/j.futures.2006.02.004>.
- May, G.H. 1996. **The future is ours: foreseeing, managing and creating the future.** Praeger Studies on the 21st Century. London, UK: Adamantine. 272 p.
- May, G.H. 1997. **The sisyphus factor or a learning approach to the future.** Futures. 29(3): 229-241. [https://doi.org/10.1016/S0016-3287\(97\)00004-9](https://doi.org/10.1016/S0016-3287(97)00004-9).
- May, G.H. 2002. **A journey to the future in the United Kingdom.** In: Dator, J.A., ed. Advancing futures: futures studies in higher education. Westport, CT: Praeger: 233-242.
- McNeil, J.R.; Engelke, P. 2016. **The great acceleration: an environmental history of the Anthropocene since 1945.** Evergreen, CO: Belknap Press. 288 p.
- Meadows, D.H.; Meadows, D.L.; Randers, J.; Behrens, W.W., III. 1972. **The limits to growth: a report for the Club of Rome's project on the predicament of mankind.** New York, NY: Universe Books. 205 p.
- Mendonça, S.; Cunha, M.P.; Kaivo-oja, J.; Ruff, F. 2004. **Wild cards, weak signals and organisational improvisation.** Futures. 36(2): 201-218. [https://doi.org/10.1016/s0016-3287\(03\)00148-4](https://doi.org/10.1016/s0016-3287(03)00148-4).
- Michalko, M. 1998. **Thinking like a genius: eight strategies used by the supercreative.** The Futurist. 32(4): 21-25.
- Michalko, M. 2000. **Four steps toward creative thinking.** The Futurist. 24(3): 18-21.
- Millet, S.M. 2011. **Managing the future: the short version.** Futuring Associates. 50 p.
- Morrison, J.L. 1992. **Environmental scanning.** In: Whitely, M.A.; Porter, J.D.; Fenske, R.H., eds. A primer for new institutional researchers. Tallahassee, FL: The Association for Institutional Research: 86-99. <http://horizon.unc.edu/courses/papers/enviroscan/default.html>.
- Muir, J. 1997. **John Muir: nature writings: the story of my boyhood and youth; my first summer in the Sierra; the mountains of California; Stickeen; selected essays.** Cronon, W., ed. New York, NY: Library of America. 928 p.
- Naisbitt, J. 2006. **Mind set!: Reset your thinking and see the future.** New York, NY: HarperCollins. 304 p.
- Noble, T. 2000. **Social theory and social change.** New York, NY: Palgrave. 260 p.
- Olson, R.L. 2016. **Missing the slow train: how gradual change undermines public policy & collective action.** Wilson Center Forgotten Problems Project. Washington, DC: Woodrow Wilson International

- Center for Scholars. https://www.wilsoncenter.org/sites/default/files/slow_threats_report_0.pdf.
- Olson, R.L.; Bengston, D.N.; DeVaney, L.A.; Thompson, T.A.C. 2015. **Wildland fire management futures: insights from a foresight panel**. Gen. Tech. Rep. NRS-152. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 44 p. <https://doi.org/10.2737/NRS-GTR-152>.
- Østergaard C.R.; Timmermans, B.; Kristinsson, K. 2011. **Does a different view create something new? The effect of employee diversity on innovation**. Research Policy. 40(3): 500-509. <https://doi.org/10.1016/j.respol.2010.11.004>.
- Ostrom, E.; Dietz, T.; Dolsak, N.; Stern, P.C.; Stonich, S.; Weber, E.U. 2002. **The drama of the commons**. Washington, DC: National Academy Press. 521 p.
- Page, S.E. 2007. **The difference: how the power of diversity creates better groups, firms, schools, and societies**. Princeton, NJ: Princeton University Press. 456 p.
- Peck, J. 2009. **Some theories of social change for futures practitioners**. Journal of Futures Studies. 14(2): 107-122. <http://www.jfs.tku.edu.tw/14-2/A06.pdf>.
- Pergams, O.R.W.; Zaradic, P. 2008. **Evidence for a fundamental and pervasive shift away from nature-based recreation**. Proceedings of the National Academy of Sciences. 105(7): 2295-2230. <https://doi.org/10.1073/pnas.0709893105>.
- Perlin, J. 1989. **A forest journey: the role of wood in the development of civilization**. New York, NY: W.W. Norton & Co. 445 p.
- Petersen, J.L. 1997. **Out of the blue: wild cards and other big future surprises**. Arlington, VA: The Arlington Institute. 189 p.
- Pilkey, O.H.; Pilkey-Jarvis, L. 2007. **Useless arithmetic: why environmental scientists can't predict the future**. New York, NY: Columbia University Press. 248 p.
- Pinchot, G. 1947. **Breaking new ground**. Commemorative ed. 1998. Washington, DC: Island Press. 522 p.
- Polak, F. 1973. **The image of the future**. Translated and abridged by E. Boulding. San Francisco, CA: Jossey-Bass/Elsevier. 319 p.
- Putnam, R.D. 1995. **Bowling alone: America's declining social capital**. Journal of Democracy. 6(1): 65-78. <https://doi.org/10.1353/jod.1995.0002>.
- Putnam, R.D.; Feldstein, L. 2004. **Better together: restoring the American community**. Parsippany, NJ: Simon & Schuster. 336 p.
- Redman, B.R. 1959. **The portable Voltaire**. New York, NY: Viking Press. 569 p.
- Rejeski, D.; Olson, R.L. 2006. **Has futurism failed?** The Wilson Quarterly. Winter: 14-21. http://archive.wilsonquarterly.com/sites/default/files/articles/WQ_VOL30_W_2006_Article_01.pdf.
- Ridley, M. 2010. **The rational optimist: how prosperity evolves**. New York, NY: HarperCollins. 480 p.
- Riley, P. 2012. **On the probability of occurrence of extreme space weather events**. Space Weather. 10(2). <https://doi.org/10.1029/2011SW000734>.
- Ross, L.; Arrow, K.; Cialdini, R.; Diamond-Smith, N.; Diamond, J.; Dunne, J.; Feldman, M.; Horn, R.; Kennedy, D.; Murphy, C.; Pirages, D.; Smith, K.; York, R.; Ehrlich, P. 2016. **The climate change challenge and barriers to the exercise of foresight intelligence**. BioScience. 66(5): 363-370. <https://doi.org/10.1093/biosci/biw025>.
- Rymer, R. 2012. **Vanishing voices**. National Geographic. 222(1): 60-93. [July].
- Saffo, P. 2007. **Six rules for effective forecasting**. Harvard Business Review. 85(7-8): 122-131.
- Sarewitz, D.; Pielke, R.A., Jr.; Byerly, R., Jr., eds. 2000. **Prediction: science, decision making, and the future of nature**. Washington, DC: Island Press. 400 p.
- Scarce, D.; Fulton, K.; the Global Business Network. 2004. **What if? The art of scenario thinking for nonprofits**. Emeryville, CA: Global Business Network. 109 p.

- Schnaars, S.P. 1989. **Megamistakes: forecasting and the myth of rapid technological change**. New York, NY: The Free Press. 224 p.
- Schwartz, P. 1996. **The art of the long view: planning for the future in an uncertain world**. New York, NY: Currency Doubleday. 272 p.
- Schwartz, P. 2004. **Inevitable surprises: thinking ahead in a time of turbulence**. New York, NY: Gotham Books. 247 p.
- Sherden, W.A. 1998. **The fortune sellers: the big business of buying and selling predictions**. New York, NY: John Wiley. 308 p.
- Simao, C. 2015. **Autonomous cars: the most disruptive innovation ever**. Geospatial World. November 10, 2015. [Originally published on Hexagon's Shaping Change blog]. <https://www.geospatialworld.net/article/autonomous-cars-the-most-disruptive-innovation-ever/>.
- Simon, J.L. 1981. **The ultimate resource**. Princeton, NJ: Princeton University Press. 415 p.
- Slaughter, R.A. 1993. **Futures concepts**. Futures. 25(3): 289-314. [https://doi.org/10.1016/0016-3287\(93\)90138-j](https://doi.org/10.1016/0016-3287(93)90138-j).
- Slaughter, R.A. 1995. **The foresight principle: cultural recovery in the 21st century**. Westport, CT: Praeger. 232 p.
- Slaughter, R.A. 1999. **A new framework for environmental scanning**. Foresight. 1(5): 441-451. [https://doi.org/10.1016/0016-3287\(93\)90138-j](https://doi.org/10.1016/0016-3287(93)90138-j).
- Sommers, C. 2012. **Think like a futurist: Know what changes, what doesn't, and what's next**. San Francisco, CA: Jossey-Bass. 254 p.
- Staley, D.J. 2007. **History and future: using historical thinking to imagine the future**. Lanham, MN: Lexington Books. 190 p.
- Steffen, W.; Broadgate, W.; Deutsch, L.; Gaffney, O.; Ludwig, C. 2015. **The trajectory of the Anthropocene: the Great Acceleration**. Anthropocene Review. 2(1): 81-98. <https://doi.org/10.1177/2053019614564785>.
- Tainter, J.A. 1990. **The collapse of complex societies**. New Studies in Archaeology Series. Cambridge, UK: Cambridge University Press. 262 p.
- Taleb, N.N. 2010. **The black swan: the impact of the highly improbable**. 2nd ed. New York, NY: Random House. 480 p.
- Tetlock, P.E. 2005. **Expert political judgment: How good is it? How can we know?** Princeton, NJ: Princeton University Press. 352 p.
- Toffler, A. 1970. **Future shock**. New York, NY: Random House. 505 p.
- Toffler, A. 1978. **Foreword**. In: Maruyama, M.; Harkins, A.M., eds. Cultures of the future. The Hague, the Netherlands: Mouton: ix-xi.
- Toth, F.L. 2008. **Dealing with surprises in environmental scenarios**. In: Alcamo, J., ed. Environmental futures: the practice of environmental scenario analysis. Amsterdam, the Netherlands: Elsevier: 169-193.
- Tversky, A.; Kahneman, D. 1974. **Judgment under uncertainty: heuristics and biases**. Science. 185(4157): 1124-1131. <https://doi.org/10.1017/cbo9780511809477.002>.
- United Nations Population Division. 2015. **World population prospects: the 2015 revision, key findings and advance tables**. Working Paper No. ESA/P/WP.241. New York, NY: UN Department of Economic and Social Affairs. https://esa.un.org/unpd/wpp/Publications/Files/Key_Findings_WPP_2015.pdf.
- Voros, J. 2001. **Reframing environmental scanning: an integral approach**. Foresight. 3(6): 533-551. <https://doi.org/10.1108/14636680110697200>.
- Voros, J. 2003. **A generic foresight process framework**. Foresight. 5(3): 10-21. <https://doi.org/10.1108/14636680310698379>.
- Walker, B.; Salt, D. 2006. **Resilience thinking: sustaining ecosystems and people in a changing world**. Washington, DC: Island Press. 192 p.

- Watkins, M.D.; Bazerman, M.J. 2003. **Predictable surprises: the disasters you should have seen coming.** Harvard Business Review. 81(3): 5-12.
- Watson, J.E.M.; Shanahan, D.F.; Di Marco, M.; Allan, J.; Laurance, W.F.; Sanderson, E.W.; Mackey, B.; Venter, O. 2016. **Catastrophic declines in wilderness areas undermine global environment targets.** Current Biology. 26(21): 2929-2934. <https://doi.org/10.1016/j.cub.2016.08.049>.
- Wayner, P. 2013. **Future ride.** Self publ.; printed in Lexington, KY. 203 p. ISBN 9781484123331.
- Weeks, D.; Malone, P.; Welling, L. 2011. **Climate change scenario planning: a tool for managing parks into uncertain futures.** Park Science. 28(1): 26-32.
- Weiner, E.; Brown, A. 2005. **FutureThink: how to think clearly in a time of change.** Upper Saddle River, NJ: Pearson Prentice Hall. 286 p.
- Wildlife Conservation Society Futures Group and Bio Economics Research Associates. 2007. **Futures of the wild.** Bronx, NY: The Wildlife Conservation Society. 36 p.
- World Health Organization. 2015. **Antimicrobial resistance.** Fact Sheet No. 194, updated April 2015. <http://who.int/mediacentre/factsheets/fs194/en/>.
- Ziegler, W. 1991. **Envisioning the future.** Futures. 23(5): 516-527. [https://doi.org/10.1016/0016-3287\(91\)90099-n](https://doi.org/10.1016/0016-3287(91)90099-n).

Bengston, David N. 2017. **Ten principles for thinking about the future: a primer for environmental professionals.** Gen. Tech. Rep. NRS-175. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 28 p. <https://doi.org/10.2737/NRS-GTR-175>.

Every decision we make is about the future, but most of us are never taught how to think critically about it. This guide addresses this issue by identifying and reviewing 10 principles for thinking about the future, along with related strategies for improving environmental foresight. The principles and strategies are drawn from the transdisciplinary field of futures studies. Taken together, these principles and strategies can help guide environmental planners, managers, and policy makers toward well-considered expectations for the future.

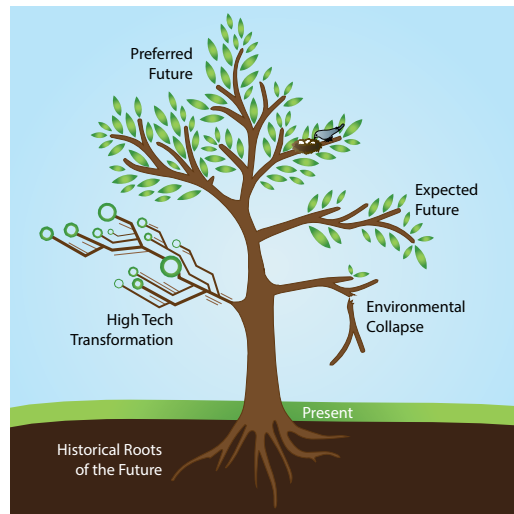
KEY WORDS: foresight, futures, strategies, futures research, futures studies

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.





Northern Research Station
www.nrs.fs.fed.us