

# Exploring Managerial Responses to Uncertainty

Scan™ documents about scenario planning and horizon scanning—understanding and managing uncertainty

August 2020

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## **Exploring Managerial Responses to Uncertainty**

During the past couple months, Scan™ has made publicly available two dozen documents that look at societal, commercial, and managerial challenges that the coronavirus-disease-2019 (covid-19) pandemic is creating for decision makers.

Common threads across these documents are the increased level of uncertainty that the covid-19 pandemic is causing and the difficulties of dealing with the future when so much remains impossible to foresee.

The Scan team has decided to assemble a range of discussions from the past six years that look at ways to understand and manage uncertainty.

If you have comments or wish to receive additional information, please contact Scan Director Martin Schwirn at [mschwirn@sbi-i.com](mailto:mschwirn@sbi-i.com).

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August 2020

SoC1174

## Effects of and Responses to Uncertainty

By Martin Schwirn (Send us [feedback](#).)

The year 2020 has made decision makers aware that uncertainty is a constant companion. In February 2020, the coronavirus-disease-2019 (covid-19) pandemic put a very sudden and immediate stop to 128 months of economic expansion in the United States—the longest expansion the country has experienced. Other countries experienced a similarly long period of growth with the same abrupt end, placing the economic landscape in disarray. Then, in May 2020, the death of George Floyd led to an eruption of civil-rights activities in the United States, and many European countries also began examining their own treatment of minorities. The social fabric is in flux. Both developments are powerful reminders that uncertainty is a chaperone of any decision and that decision makers should make addressing uncertainty a constant consideration.

In the business world, uncertainty is perhaps the only certainty; however, heightened uncertainty can be very difficult to resolve. New York University (New York, New York) Leonard N. Stern School of Business professor Geeta Menon and Dartmouth College (Hanover, New Hampshire) Tuck School of Business associate professor Ellie Kyung point out that people's natural reaction to experiencing uncertainty is to seek additional information to reduce the level of uncertainty. The current problem is that insufficient authoritative information exists to diminish uncertainty about the covid-19 situation—after all, medical, legislative, and economic experts are learning as events unfold. Drs. Menon and Kyung stress that uncertainty is not a monolithic concept and that three types of uncertainty exist: probability uncertainty, ambiguity uncertainty, and complexity uncertainty. *Probability uncertainty*

refers to situations in which identifying risk levels is difficult for decision makers. *Ambiguity uncertainty* refers to situations in which available information is conflicting, imprecise, or insufficient. *Complexity uncertainty* refers to situations in which a particular matter has high technical complexity, making it difficult for laypeople to understand. Identifying which types of uncertainty are at play in a situation could aid in gaining an understanding of the texture of a problem and its underlying issues. Drs. Menon and Kyung provide strategies for addressing the three types of uncertainty, but applying some of those strategies under current circumstances can be difficult. For example, the

*Uncertainty is perhaps the only certainty.*

strategy for addressing probability uncertainty is to comply with recommendations from experts, and the strategy for addressing complexity uncertainty is to seek experts to break down and

simplify complex information for laypeople; however, in the current medical, economic, and societal climates, finding authoritative sources of knowledge can be difficult.

Interacting economic and societal dynamics have introduced a multidimensional development that reaches across several spheres of expertise. An illustrative point is many observers' assessment that coronavirus-response measures highlight the inequality among segments of the population. Many knowledge workers experience the covid-19 pandemic as a mere nuisance that requires them to stay at home but has no substantial effect on their employment status and income; in contrast, many frontline and low-income workers not only face a high risk of exposure to the coronavirus but also see threats to their livelihood in the form of layoffs and furloughs. Awareness of this disparity likely feeds into rising tensions about civil-rights matters,

thereby creating complex interactions among the medical, economic, and societal spheres of life.

Drs. Menon and Kyung also point to a very interesting human condition, referencing a 2016 article by researchers from University College London (London, England) and other institutions. According to the article, a study revealed that people are calmer when they know for certain that they will experience an electric shock than they are when they know that they have a 50% chance of experiencing such a shock. Similarly, uncertainty about job security has a more problematic effect on humans than does the actual loss of a job. People perceive uncertainty as a condition that is very challenging to deal with. Meanwhile, a team comprising researchers from Yale University (New Haven, Connecticut) and other institutions surmises that unpredicted uncertainty (such as the situation that the covid-19 pandemic has produced) can increase people's tendency to experience *paranoia*—a persistent feeling of suspicion and distrust and the belief that other people have malicious intentions. Yale's Erin Reed, lead author of the team's paper about this subject, explains, "We think of the brain as a prediction machine; unexpected change, whether social or not, may constitute a type of threat—it limits the brain's ability to make predictions.... Paranoia may be a response to uncertainty in general" ("Unexpected uncertainty can breed paranoia, researchers find," Yale News, 9 June 2020; online). If the team's hypothesis about uncertainty's role in causing paranoia is correct, uncertainty can have negative effects on rational decision-making—even for corporate decision makers. If decision makers expect malicious intentions, they could focus and base their decisions on a misleading subset of issues. That some malicious intent could actually exist—for example, competitors' attempting to take advantage of missteps during a time of general change—adds complexity to the situation. The research provides a glimpse into the complicated dynamics that uncertainty creates for decision makers.

Such challenging decision-making environments and conditions should not deter leaders from responding proactively to uncertainty, but some very basic conditions apply. First, organization leaders should share information about the organization's situation and strategic intentions. Glen Rabie, CEO of analytics-software provider Yellowfin BI (Melbourne, Australia), highlights that individuals will seek and process data whether or not an organization decides to share those data. He also makes the point that leaders should communicate available data and the resulting decisions. In general, decision makers should not give up their opportunities to provide information. If one organization's leaders fail to communicate, other organizations—including competitors—will be happy to fill the information vacuum with their own information. Second, leaders should develop a landscape of involved uncertainties. Ezra Maddox, an executive director at J. P. Morgan (JPMorgan Chase & Co.; New York, New York), recently penned an article for *Treasury & Risk* that offers five steps that leaders should take when they need to protect their companies during periods of economic uncertainty. His recommendations focus on financial institutions but contain good advice for companies from every industry. One of his recommendations is to create scorecards for counterparties to assess their risk to the company (analyzing partners across the value chain seems prudent in general). Maddox also recommends using data analysis in efforts to identify future risks and using advanced data analytics to monitor risk going forward.

Scenario planning can aid in the development of a deeper understanding of potential futures. As [SoC1173 — Scenario Planning Is En Vogue—Again](#), [SoC1172 — Contemplating Scenarios: Dynamics Count](#), and [SoC1166 — Scenario Planning for the Pandemic's Aftermath](#) discuss, scenario planning is a tool to address uncertainty in decision-making.

## SoC1174

### Signals of Change related to the topic:

[SoC1166 — Scenario Planning...](#)  
[SoC1161 — Scanning...](#)  
[SoC1154 — Life after the Time of Coronavirus](#)

### Patterns related to the topic:

[P1482 — Supply-Chain Risks](#)  
[P1470 — Tackling Uncertainty](#)  
[P0913 — Certainty of Uncertainty](#)

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SoC1173

## Scenario Planning Is En Vogue—Again

By Martin Schwirn (Send us [feedback](#).)

Scenario planning emerged in the 1970s as a tool for developing an understanding of how the future can develop—or more precisely, what alternatives of the future are plausible. The purpose of scenario planning is not to predict the future, because predicting the future is impossible; instead, the scenario-planning concept relies on the understanding that if a person has considered the most extreme outcomes that plausibly could occur in the years ahead, that person has likely considered whatever the actual future will be. Much of the seminal work in developing scenario planning as a management tool occurred at Royal Dutch Shell (The Hague, Netherlands) and SRI International (Menlo Park, California), and SRI International’s scenario-planning practice is now part of Strategic Business Insights (SBI; Menlo Park, California). Scenario planning has always been a formidable tool for developing appropriate strategies and contingency plans under uncertainty; however, scenario planning tends to go overlooked during periods when strong economic growth lulls companies into complacency and decision makers into focusing on revenue generation instead of considering commercial threats and corporate vulnerabilities.

SBI’s scenario-planning practice experienced substantial interest following the dot-com-bubble burst in spring 2000, the terror attacks in September 2001, and the financial crisis of 2007–08. This interest is understandable. Decision makers found themselves confronting substantially changed environments in a world marked by uncertainty. Although uncertainty is always part of corporate planning and decision-making, leaders tend to brush aside related concerns during times of substantial financial success. Now that the coronavirus-disease-2019 (covid-19) pandemic is affecting every area of

commercial activity and the reemergence of a strong civil-rights movement promises to bring substantial social change, scenario planning is again garnering tremendous interest because people want to understand future uncertainties. One concern is that many of the current self-proclaimed practitioners of scenario planning are just now starting to learn about scenario planning themselves—after all, the world seems interested in understanding the uncertainties and vagaries of the future only every decade or so. Recent discussions present introductions to and results of scenario-planning efforts. Each of these discussions offers valuable contributions, but some considerations require context.

Sarah Watt, a senior director and analyst

for Gartner’s (Stamford, Connecticut) supply-chain group, recently highlighted that scenario planning enables leaders of supply-chain operations to look at a range of outcomes that disruption

from the covid-19 pandemic might produce. Her discussions provide three scenarios: A short-term disruption that she identified as the best-case scenario, a long-term disruption that includes a recession, and a secondary disruption—perhaps the result of covid-19 or a natural disaster or another major event—that can follow either of the first two scenarios. What Watt created is perhaps less a set of scenarios and more a risk timeline or a set of managerial hurdles for the coming two years. The best-case-scenario label is always a concern because it assumes a very uniform situation of challenges for decision makers. But scenarios depend on the industry and even the company that is engaging in scenario planning. For instance, Zoom Video Communications (San Jose, California) just had a very successful period because the covid-19 pandemic changed people’s behavior (the implementation of

*Uncertainty is always part of corporate planning and decision-making.*

lockdown and social-distancing measures suddenly and dramatically increased people's use of communications technologies). A best-case scenario for Zoom concerns market success and differs substantially from a best-case scenario for public health and society.

In a June 2020 *Knowledge@Wharton* article, Dr. Scott Snyder—a Wharton School of the University of Pennsylvania (Philadelphia, Pennsylvania) senior fellow and partner in the Philadelphia, Pennsylvania, office of Heidrick & Struggles International (Chicago, Illinois)—and colleagues from Heidrick & Struggles laid out four scenarios to address uncertainties about the workforce in a postpandemic world. In the first scenario, trust among countries, organizations, and people has diminished. In the second scenario, various technologies have advanced, but human interactions have a high value. In the third scenario, an extended recession has damaged trust among communities, institutions, and people. In the fourth scenario, economic struggles have led to communities', families', and nongovernment organizations' supporting one another. These four scenarios provide a very good understanding of what kinds of societal interactions could become dominant as a result of the covid-19 pandemic. For many companies, the scenarios are probably too abstract, and the article's authors highlight the need for companies to use these scenarios in company-specific work to arrive at strategic decisions. These scenarios—like many other scenarios that Scan™ has discussed in recent months—outline generic results of general dynamics; however, because companies are not generic entities in generic situations, scenarios require customizing according to each company's particular situation.

A June 2020 *Harvard Business Review* article discusses how Geisinger Health System (Danville, Pennsylvania) used scenario planning to prepare its operations for the effects of the covid-19 pandemic. The company's steering group defined 11 core areas of the business—including human resources, information technology, and finance—

that were likely to experience disruption and therefore require operational adjustments. The steering group then developed plausible futures and considered their implications for business and patient care. The steering group might be correct in claiming that the world will never again look the way it did before the covid-19 pandemic hit; however, even if it did, the Geisinger steering group's scenario-planning approach identified areas with room for improvement and operations that can be more efficient.

A broader look at future possibilities—which scenario planning enables—can make decision makers aware of crucial blind spots in their planning and holes in their strategies. Elisabeth Braw directs the Modern Deterrence project at the Royal United Services Institute for Defence and Security Studies (London, England) and recently argued that governments and businesses should hire a devil's advocate, because “forcing governments and businesses to institutionalize doubt—by putting hackers and red teams on the payroll—would stop groupthink and could prevent catastrophes” (“Want to Avoid the Next Pandemic? Hire a Devil's Advocate.” *Foreign Policy*, 6 May 2020; online). And France's Defense Innovation Agency (Ministry of the Armies; Paris, France) has recruited a group of science-fiction writers to develop disruptive scenarios for use in efforts to plan for unusual and unexpected conflicts. The thinking of such outside groups can provide alerts about major disruptions that members of the French military might never have thought of. For example, the European Union commissioned *Infected*—a 2012 comic book about the threat of global pandemics. The comic's narrative features many developments that resemble experiences from recent months. Although the comic book certainly made readers aware of potential dangers, decision makers appear to have failed to prepare for the situations that the comic describes.

## SoC1173

### Signals of Change related to the topic:

SoC1166 — Scenario Planning...  
SoC1161 — Scanning...  
SoC1154 — Life after the Time of Coronavirus

### Patterns related to the topic:

P1482 — Supply-Chain Risks  
P1470 — Tackling Uncertainty  
P0913 — Certainty of Uncertainty

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SoC1172

## Contemplating Scenarios: Dynamics Count

By Martin Schwirn (Send us [feedback](#).)

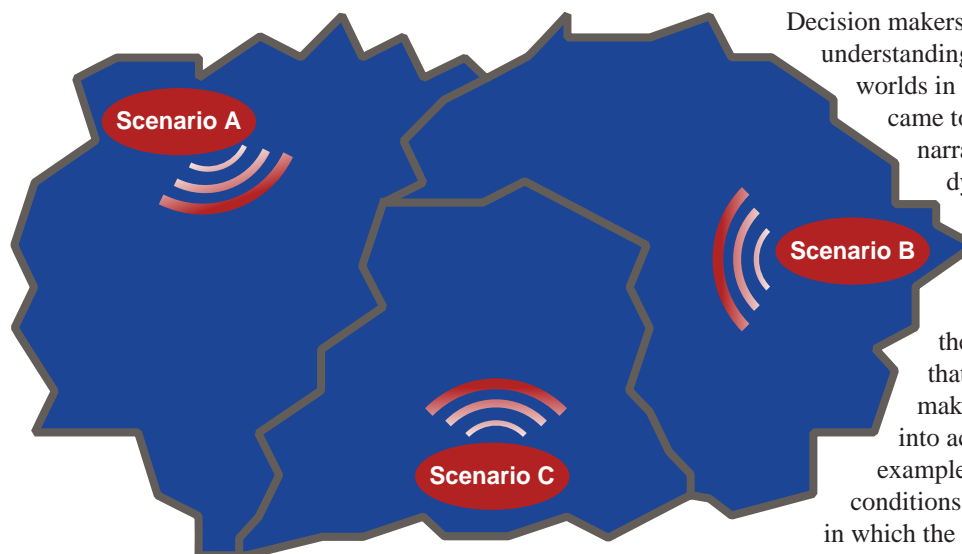
May 2020's SoC1154 — [Life after the Time of Coronavirus](#) points to the use of scenarios to understand what changes the coronavirus-disease-2019 (covid-19) pandemic might bring. June 2020's SoC1166 — [Scenario Planning for the Pandemic's Aftermath](#) highlights that although such a look at potential futures will help prime decision makers' thinking to understand what types of challenges lie ahead, general scenarios fail to address individual strategic and decision-making needs. Only customized scenario-planning efforts can help decision makers move from gaining awareness of a changing world to preparing for such a world organizationally.

Short descriptions of scenarios provide just a starting point. For strategic-planning purposes, only full-blown narratives of scenarios will offer the granularity necessary to understand economic and commercial dynamics. Vague descriptions of futures offer a stagnant snapshot that shows

an outcome. But such vague descriptions fail to explain how the world in that outcome came to be and in which direction it will move going forward.

Many scenarios that discuss how the world might develop in the coming years consist of a paragraph or two about what the global economy will look like five years or a decade (or even decades) from the present. But decision makers must look closely at details and underlying dynamics. Scenario planning for strategic decision-making captures uncertainty by looking at the full range of plausible developments. If decision makers then look at future worlds at the edges and take them into consideration for strategy development, they implicitly capture the worlds between these extremes, thereby preparing for the full range of potential outcomes. The figure shows how extreme visions of potential futures can cover the space of conceivable developments in the coming years.

### Alternative Scenarios



Source: SBI

Even when capturing extremes, simply looking at a future outcome is insufficient. Decision makers require an understanding of how the worlds in future outcomes came to be and a narrative about the dynamics that led up to these outcomes. Narratives provide the dynamics that decision makers must take into account. For example, given current conditions, an outcome in which the GDP of the United States grows by 3.5%



from 2024 to 2025 seems encouraging. But in this outcome, did the economy achieve that GDP growth because of a V-shape recovery with normalizing conditions in 2021, or was a four-year recession necessary to produce a turnaround in 2025? Both these scenarios—the V-shape-recovery scenario and the four-year-recession scenario—result in a GDP growth of 3.5% from 2024 to 2025, but the scenarios’ dynamics differ substantially; therefore, the two scenarios have different economic climates in which an organization must function during the four years leading up to 2025. Moreover, the dynamics of the V-shape-recovery scenario will affect the overall size of the economy very differently from how the dynamics of the four-year-recession scenario will. Although both scenarios produce a GDP growth of 3.5% from 2024 to 2025, the dynamics of the V-shape-recovery scenario produce a larger overall economy—four years (2021 to 2025) of 3.5% GDP growth per year will result in a substantially larger economy by 2025 than will a scenario in which such growth occurs only from 2024 to 2025. Business and consumer spending will differ significantly between the two scenarios. Dynamics matter. A snapshot of an economy in 2025 provides an idea; a story about how the economy reached its 2025 state provides an understanding of how to operate an organization during the years leading up to 2025.

Other types of information also require a deeper dive than general descriptions can offer. Assuming that the current use of communication technologies will lead to an outcome in which people participate in videoconferencing frequently in both their professional life and their private life, will the main providers of videoconferencing solutions be massive companies such as Cisco Systems (San Jose, California) and Microsoft (Redmond, Washington) or smaller companies such as Zoom Video Communications (San Jose, California) and LogMeIn (Boston Massachusetts)? Or will an application from some new start-up or an app from a Chinese company—for example, Tencent Meeting from

Tencent Holdings (Shenzhen, China)—dominate the market? Clearly, videoconferencing-solution providers and software companies are not the only parties that will have to consider such differing competitive landscapes. Similar considerations exist for an outcome in which the variety of digital-payment solutions has become very broad. Will Apple (Cupertino, California) and Google (Alphabet; Mountain View, California) find success with their credit cards and establish a comprehensive transaction infrastructure? Or will Ant Financial Services Group (Hangzhou, China), Square (San Francisco, California), Venmo (PayPal Holdings; San Jose, California), and a dozen other providers of digital-payment solutions establish a fragmented and confusing market environment? Or will blockchain-based payment systems become successful international banking and payment tools? Whatever the case, the outcome is the same on the surface: A new payment solution has become successful, and transactional behavior has changed. But market structures differ substantially across these three scenarios.

Brief descriptions of scenarios and their overall shape provide frames, but only dynamics provide narratives that decision makers can work with when they are considering strategy alternatives. Looking at scenario overviews is like looking at a mountain from afar. From a distance, a person can likely tell which mountain wall is the steepest, which route to the top of the mountain is the shortest, and maybe where the most snow has accumulated; however, that person probably cannot tell which climb will be the most difficult and dangerous and which view from the mountaintop will be the most rewarding. Similarly, a general description of scenarios is just an overview of a situation—a starting point; a decision maker cannot use it to gain a thorough understanding of which challenges will require addressing on the path forward.

## SoC1172

### Signals of Change related to the topic:

SoC1166 — ...Planning for the...Aftermath  
SoC1154 — Life after...Coronavirus  
SoC193 — A Tale of Three Cities

### Patterns related to the topic:

P1494 — Managing Uncertainty  
P1470 — Tackling Uncertainty  
P0913 — Certainty of Uncertainty

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SoC1166

## Scenario Planning for the Pandemic's Aftermath

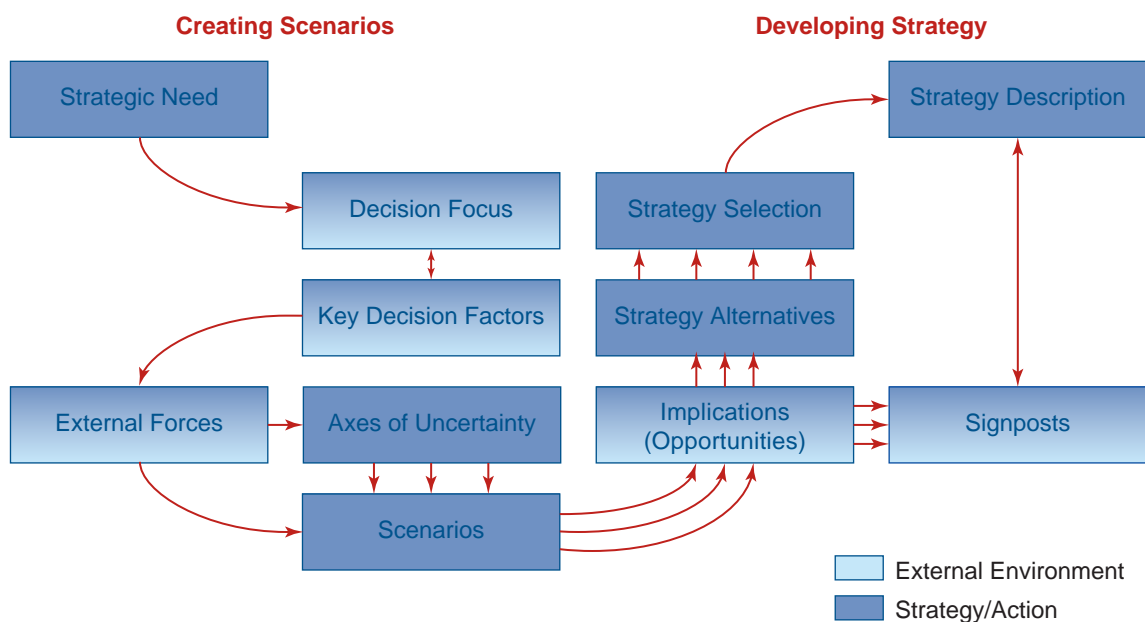
By Martin Schwirn (Send us [feedback](#).)

May 2020's SoC1154 — *Life after the Time of Coronavirus* points to the use of scenarios to understand what changes the coronavirus-disease-2019 (covid-19) pandemic might bring. But general scenarios fail to address individual strategic and decision-making needs—the individual needs that make every industry and every company within every industry unique. General scenarios offer a coarse outlook that can aid in developing an understanding of the range and magnitude of potential challenges moving forward. But only customized scenario-planning efforts can help decision makers move from gaining awareness of a changing world to preparing for such a world in

ways that will enable them to weather the changes and thrive in a new commercial and societal landscape.

Strategic Business Insights' (SBI's) scenario-planning service has a framework that illustrates the steps and requirements of building narratives about potential futures (scenarios) that guide decision makers' thinking and strategy development. In the context of SBI's framework, general scenarios represent overviews that look at axes of uncertainty and related scenarios and therefore tackle only a sliver of decision-making needs. Axes of uncertainty represent the major considerations that pandemic-related scenarios have to take into account. In the context of the

### Full Scenario-Planning Process



Source: SBI

covid-19 pandemic, many researchers look at, for instance, the axes of global versus local, economic recovery versus ongoing recession, and health-care challenges versus health-care advances.

SoC1154 discusses the look that futurist Sohail Inayatullah and consultant Peter Black took at how the future might play out. On the basis of the analysis of hundreds of published documents, they developed four distinct future scenarios: a disaster scenario, a respite scenario, a progress scenario, and a gloom scenario. Similarly, a German think tank recently looked at the covid-19 pandemic's effects on the economic and societal landscapes and developed four distinct scenarios: an isolation scenario, a collapse scenario, a tribal-structures scenario, and an adjustment scenario. In the isolation scenario, individuals and countries keep a distance from one another; traveling has become difficult, and participating in public events requires health checks. In the collapse scenario, the coronavirus has caused the world to enter a permanent crisis, and national interests trump global considerations. In the tribal-structures scenario, local economies thrive, and people focus on small circles of friends and family. Finally, in the adjustment scenario, global society is learning from the crisis and emerges strengthened.

These scenarios outline plausible futures that decision makers might have to deal with; however, they represent extreme outcomes, and the actual future will likely be somewhere in between or a mixture of them all to various degrees and within certain ranges. For instance, a world of tribal structures would work for only certain products and services. Seeing how car manufacturing and shipbuilding could become truly local affairs is difficult. And such shortcomings point to the limitations of general scenarios: They can neither reflect the needs of particular companies nor provide guidance for such companies' decision makers. In reality, decision makers require scenarios that take their specific business, industry, and markets

into consideration. A one-size-fits-all approach does not allow effective strategy development. General scenarios merely provide an idea of what challenges might lie ahead for many companies and are shortcuts to understanding what issues may require addressing.

In contrast, the framework of SBI's scenario-planning service not only produces scenarios with deeper and more textured narratives but also supports strategic decision-making that focuses on the needs and markets of the decision makers' companies. Companies must first decide what their strategic need is and what the resulting and related decision focus will be. For example, in reacting to the covid-19 pandemic, does a company want to establish more robust operations (including the logistics of supply chains) to weather future crises more effectively, or does it want to take advantage of the current disruption to acquire competitors in an effort to create more comprehensive product portfolios? Clearly, these two strategic needs will lead to scenarios that look at very different factors. But a scenario is a look at the marketplace, not a strategic response. The entire right side of SBI's framework then guides decision makers through a process that results in a custom strategy. After developing and gaining an understanding of scenarios, companies will have to put themselves into these worlds, consider implications and response alternatives, and create robust and flexible strategies that address their situations in the context of potential future worlds that the covid-19 pandemic might create.

General scenarios remain valuable starting points to trigger strategic thinking and to provide the awareness that strategic responses are necessary to deal with changes in the economic and societal landscapes. But customized scenarios and strategy development are indispensable in preparing companies for the future that will emerge, given all the uncertainties that lie on the pathway to this future.

## SoC1166

### Signals of Change related to the topic:

SoC1161 — Scanning...  
SoC1154 — Life after...Coronavirus  
SoC885 — Uncertain Predictability...

### Patterns related to the topic:

P1482 — Supply-Chain Risks  
P1470 — Tackling Uncertainty  
P0913 — Certainty of Uncertainty

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**SoC1161**

## Scanning: The Pandemic and Its Implications

 By Martin Schwirn (Send us [feedback](#).)

The emergence of the coronavirus and coronavirus disease 2019 (covid-19) and the occurrence of the covid-19 pandemic and the resulting economic slowdown were not unforeseeable; People either ignored or simply brushed aside the warning signs during the decade of substantial and continuous growth since the Great Recession. April 2020's [SoC1154 — Life after the Time of Coronavirus](#) dispels the myth that the emergence and spread of the coronavirus is a *black swan*—a term that Nassim Taleb uses in his 2007 book *The Black Swan: The Impact of the Highly Improbable* to refer to an unpredictable large-magnitude event that has major consequences. Business scholars Max Bazerman and Michael Watkins provide a term that is much more suitable for use in describing the rise and spread of the coronavirus: *predictable surprise*. In their 2004 book *Predictable Surprises: The Disasters You Should Have Seen Coming and How to Prevent Them*, Drs. Bazerman and Watkins define a *predictable surprise* as an event (or set of events) that surprises a person or group even though that person or group was aware of all the information necessary to anticipate the event and its consequences. And in their 2015 book *Superforecasting: The Art and Science of Prediction*, Philip Tetlock and Dan Gardner come to the conclusion that many events that people consider black swans are actually gray swans and that black swans are not nearly as wildly unpredictable as many people assume they are.

Two particularly prominent strands of developments and warning signs should have raised concerns about the possibility that a pandemic could occur. First, several disease outbreaks occurred during the past 20 years. Even casual observers will remember many

of these outbreaks. From 2002 to 2004, severe acute respiratory syndrome (SARS), which the SARS coronavirus causes, affected some 29 countries. Between 2009 and 2010, swine influenza (flu)—which multiple strains of the influenza virus, including the influenza A virus subtype H1N1, cause—affected many regions of the world; the World Health Organization (Geneva, Switzerland) declared swine flu a pandemic only after hundreds of thousands of people succumbed to it. Middle East respiratory syndrome (MERS), which the MERS coronavirus causes, broke out in 2012 (additional smaller outbreaks occurred in 2015 and 2018). And these outbreaks are only some of the most prominent flu-related outbreaks (outbreaks of Ebola-virus disease occurred between 2013 and 2016, and outbreaks of Zika-virus disease occurred between 2015 and 2016). Such outbreaks clearly are not exceptions; therefore, the emergence of a new virus in 2019 is a predictable surprise,

not a black swan. Second, many experts issued warnings about the emergence of new pandemics. Most prominently, Bill Gates, cofounder of Microsoft (Redmond, Washington) and the Bill & Melinda Gates Foundation (Seattle, Washington), warned about a deadly pandemic repeatedly during the past decade. In 2010, he warned that “the H1N1 flu strain got a lot of attention in 2009.... The real story is that we are lucky it wasn’t worse because we were almost completely unprepared for it” (“A better response to the next pandemic,” *GatesNotes* [blog], 18 January 2010; online). During a TED Conferences (TED Foundation; New York, New York) TED Talk in 2015, Gates underscored his concerns, explaining that “if anything kills over 10 million people in the next few decades, it’s most likely to be a highly infectious

*The purpose of Scan™ is to capture dynamic interactions in clients' external environment.*

virus.... We're not ready for the next epidemic" ("The next outbreak? We're not ready," TED Conferences, 18 March 2015; online). During a radio interview in 2016, Gates spoke with Dame Sally Davies, then England's chief medical officer, and expressed the concern that "we are a bit vulnerable right now if something that spread very quickly like a, say, a flu that was quite fatal; that would be a tragedy" ("Bill Gates: We are vulnerable to flu epidemic in next decade," BBC News, 30 December 2016; online).

Government officials have also highlighted threats to the health of thousands if not millions of people and the global economy. During a pandemic-preparedness gathering at Georgetown University Medical Center (Georgetown University; Washington, DC) in January 2017, Anthony Fauci—the longtime director of the US National Institute of Allergy and Infectious Diseases (National Institutes of Health; Bethesda, Maryland) who has moved into the spotlight during the covid-19 pandemic—warned that "there is no question that there will be a challenge to the coming administration in the arena of infectious diseases" ("Global Health Experts Advise Advance Planning for Inevitable Pandemic," Georgetown University Medical Center, 12 January 2017; online). At the Biodefense Summit that the Office of the Assistant Secretary for Preparedness and Response (US Department of Health and Human Services; Washington, DC) hosted on 17 April 2019, then US National Security Council (Washington, DC) senior director for counterproliferation and biodefense Timothy Morrison made his major concerns clear. Morrison referenced *The Great Influenza: The Epic Story of the Deadliest Plague in History*, John M. Barry's book about the 1918 flu pandemic, explaining that "a couple of lines in here...ring true when I think about what keeps me up at night and what am I really worried about" ("Advancing Biodefense," Office of the Assistant Secretary for Preparedness and Response,

17 April 2019; online). And in September 2019—mere months before the coronavirus first appeared in Wuhan, China—the US Council of Economic Advisers (Washington, DC) released its aptly titled *Mitigating the Impact of Pandemic Influenza through Vaccine Innovation* report.

Clearly, several strong signals of change existed before the coronavirus emerged. Moving forward requires looking at a potentially changed world. The covid-19 pandemic introduced new dynamics in the business, political, and societal realms, and the developments of the past three months accelerated many dynamics that had seen only weak signals of change in past years.

The purpose of Scan™ is to capture dynamic interactions among three areas in clients' external environment: commerce and competition, science and technology, and consumers and society. In the June 2020 Scan set, the Scan team presents the results of the May 2020 Scan Meeting, which focused on and revolved around developments and implications relating to the covid-19 pandemic. [Strategic Synopsis 126](#), the result of the May 2020 Scan Meeting, presents Signals of Change and Patterns about potential developments that will play out across the areas of consideration that the Strategic Synopsis highlights every month: Infrastructure, Organization, Talent, Creation, and Marketing. Some of the developments that the June 2020 Scan set highlights are novel changes that the pandemic introduced; many other developments merely represent accelerations of developments that previous Scan discussions mention (the covid-19 pandemic merely provides the circumstances necessary to drive the adoption and diffusion of new concepts, technologies, and types of business conduct that have been a long time in the making). Please find initial alerts about such developments in the "Signals of Change related to the topic" and "Patterns related to the topic" sections at the end of each Signal of Change and Pattern.

## SoC1161

### Signals of Change related to the topic:

SoC1166 — Scenario Planning...  
SoC1154 — Life after...Coronavirus  
The Scan™ Process...

### Patterns related to the topic:

P1470 — Tackling Uncertainty  
P1400 — Forewarned Is Forearmed  
P0913 — Certainty of Uncertainty

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**SoC1154**

## Life after the Time of Coronavirus

By Martin Schwirn (Send us [feedback](#).)

The coronavirus has dominated the past couple months. The virus is spreading across countries and continents and has affected commerce, supply chains, and lives in general. Although near-term developments are yet unclear, some changes to economies and societies could become permanent. This Signal of Change is general in nature because developments that relate to the coronavirus and coronavirus disease 2019 (covid-19) are still ongoing.

Many observers have called the emergence and spread of the coronavirus a “black swan.” In his 2007 book *The Black Swan: The Impact of the Highly Improbable*, Nassim Taleb uses the term *black swan* to refer specifically to an unpredictable large-magnitude event that has major consequences.

Black swans have some similarities to the *wild cards*—low-probability, high-impact events—that find use in Scan workshops and scenario-planning projects.

Many observers argue that the spread of the coronavirus is a very good example of an event that is unpredictable and is having a very unusual and unexpected effect on the global community. But neither point in this argument is accurate, and the distinction matters a great deal from decision-making and risk-management perspectives.

The occurrence of such a virulent virus was not only expectable but also predictable in the sense that the emergence of a virus-related health crisis should be unsurprising (details such as type, timing, and starting point of the outbreak clearly are beyond predictability). Obviously, two diseases reached high-profile-pandemic status during the twentieth century: the Spanish flu and HIV/AIDS. The Spanish flu killed from 50 million people to as many as 100 million people, and HIV/AIDS has killed more than 30 million people. In the first two decades of the

twenty-first century, the world experienced (in alphabetical order) Ebola-virus disease, MERS (Middle East respiratory syndrome), SARS (severe acute respiratory syndrome), swine flu, and Zika-virus disease—just to name a few diseases that reached high-profile-outbreak status. And many media outlets have reported that Bill Gates had warned about a deadly pandemic repeatedly at events and conferences during the past decade. Indeed, the cofounder of Microsoft (Redmond, Washington) and the Bill & Melinda Gates Foundation (Seattle, Washington) has outlined crucial aspects of today’s crisis. For example, at the 2017 Munich Security Conference (Munich Security Conference; Munich, Germany), Gates highlighted that “our worlds are

more tightly linked than most people realize” (speech at the Munich Security Conference, Bill & Melinda Gates Foundation, 17 February 2017; online). And a little more than a year later in

Boston, Massachusetts, at the Massachusetts Medical Society (Waltham, Massachusetts) and *New England Journal of Medicine*’s annual Shattuck Lecture, Gates cautioned that “there is one area...where the world isn’t making much progress, and that’s pandemic preparedness” (speech at the Shattuck Lecture, Bill & Melinda Gates Foundation, 27 April 2018; online).

No, the emergence of the coronavirus and the covid-19 pandemic and its effects are not black swans, nor are they wild cards. These developments are simply events that will occur when billions of people around the world are in close contact with increasing frequency. These developments are not comparable to, for example, a meteor strike that takes out a continent or the development of a steam engine that changes every aspect of life in unforeseeable ways. The emergence of the coronavirus is similar to an

*Considering plausible futures reduces the number and impact of surprises.*

industrial disaster or an earthquake: Such events happen. Such events can be small or large; however, they all relate to the way the world operates in general. Similarly, this pandemic will not be the last one, and the world had better learn lessons from this pandemic and, while moving through it, rethink risk-management practices and consider responses to future pandemics.

Contemplating some of the potential changes in commerce and policies that could occur in the coming years is worthwhile because these changes might alter the business environment in which companies operate. Many aspects of doing business might require rethinking. Andrew Winston—author of *The Big Pivot: Radically Practical Strategies for a Hotter, Scarcer, and More Open World*—recently discussed related issues. He highlights that the increasing nationalism of past years (see 2012’s [SoC597 — Nationalization and Protectionism](#) for an early discussion about such nationalism) is a hindrance to the development of not only countermeasures for pandemics but also solutions for climate change and resource depletion, because these problems are global in nature. Winston believes that the current global health crisis represents a type of situation that humanity will face with increasing frequency. Specific to the United States, he points to the need to consider implementing some sort of universal health care, because the covid-19 pandemic underscores that people who lack health care become society’s weak link. Wilson also believes that companies will step up their community involvement and rethink their global supply chains.

In a recent article on the *Journal of Futures Studies* blog, futurist Sohail Inayatullah and consultant Peter Black take a comprehensive look at how the future might play out. On the basis of the analysis of hundreds of published documents, they develop four distinct future scenarios: a disaster scenario, a respite scenario,

a progress scenario, and a gloom scenario. In the disaster scenario, ongoing pandemics and nationalist tendencies result in ongoing commercial uncertainty that negatively affects markets and results in an economic downturn—perhaps even a depression. In the respite scenario, the world community slows down the pandemic, and the coronavirus becomes simply another type of flu that the world has to deal with. In the progress scenario, major medical advances and collaboration in health care occur, and breakthroughs lead to a health-care environment that is much more resilient than is the health-care environment of today. In the gloom scenario, the virus does not have a devastating effect but lingers around. As a result, societies and economies cannot live up to their full potential, and a slow medical and commercial decline occurs in the coming years.

Such scenarios do not predict the future but describe plausible future worlds that enable decision makers to capture and manage uncertainties that relate to the coming years. Strategic Business Insights (SBI) has performed extensive scenario-planning work with dozens of companies across virtually all industries in efforts to help decision makers develop flexible and robust strategies. The future scenarios that Dr. Inayatullah and Black outline present reasonable worlds that SBI’s scenario-planning efforts also could have revealed. The scenarios represent conceivable extreme outcomes, and the actual future will likely be somewhere in between or a mixture of them all to various degrees and within certain ranges. But decision makers had better look at these scenarios and consider what they would do in each of the futures the scenarios describe. Considering plausible futures reduces the number and impact of surprises, and having a strategic plan for each of these futures will help decision makers hit the ground running as the actual future unfolds.

## SoC1154

### Signals of Change related to the topic:

SoC1118 — ...Early Disease Detection  
SoC1080 — Combating Antibiotic Resistance  
SoC920 — Halt the Epidemics!

### Patterns related to the topic:

P1344 — Affecting Microbiomes  
P1005 — Preventing Epidemics  
P0633 — Diseases’ Pathways

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## SoC1104

## Be Aware of Big Data's Limitations

By Martin Schwirn (Send us [feedback](#).)

**B**ig-data applications have proliferated across many application areas in most industries. Without question, many application areas can benefit from the analysis of a massive amount of data. [SoC034 — eScience](#) from 2003 highlights that IT not only enables scientists to generate a massive amount of experimental data but also provides scientists with tools for sharing and analyzing those data and collaborating in new ways. But contrary to the opinions of many observers who believe in big data's absolute power, big data is not a panacea. Many problem situations do not lend themselves to the use of big-data approaches. In some cases, the number of occurrences of particular incidents of concern is simply so low that the results of big-data analytics become unreliable. In other cases, the results of big-data analytics do not justify the efforts that are necessary to collect and manage the data and then to make sense of the analytics and derive meaningful actions.

IBM (Armonk, New York) researchers spent years developing Watson—a question-answering computer system they designed to make sense of large amounts of data (see [SC-2010-07-07-085](#) for the first time Scan™ reported about Watson). The company's researchers then spent years working on many applications in which they hoped Watson would prove beneficial. In a press release from early 2012, IBM touted the benefits of Watson, citing Columbia University (New York, New York) professor of clinical medicine Herbert Chase, who claimed that “Watson represents a technology breakthrough that can help physicians improve patient outcomes” (“IBM Forms Watson Healthcare Advisory Board,” IBM, 1 March 2012; online). This promise appears likely to go

unfulfilled. A *Wall Street Journal* article from 2018 highlights that although IBM promised that Watson represents a large step forward in the treatment of cancer, “six years and billions of dollars later, the diagnosis for Watson is gloomy” (“IBM Has a Watson Dilemma,” *Wall Street Journal*, 11 August 2018; online). Multiple issues contributed to Watson's lack of success, and reportedly no published research proves that the computer system has contributed to any improvements in patient outcomes. For instance, the lack of data about cancers that are rare or recurring can result in Watson's making mistakes.

*The amount of effort that goes into data collection and preparation and the related costs can surprise companies that intend to work with advanced data analytics.*

Although IBM uses Watson for many applications that are not specific to the field of medicine—for example, in customer-service solutions and for general data management—it is not the only company that perceives the health-care industry as a promising target for advanced data diagnostics. Alphabet (Mountain View, California), Amazon.com (Seattle,

Washington), Microsoft (Redmond, Washington), and Royal Philips (Amsterdam, Netherlands) all have a range of applications that analyze and manage health-care-industry-related information. But IBM is now highlighting issues that should be of concern to prospective users of big data and AI. Arvind Krishna, senior vice president of cloud and cognitive software at IBM, recently acknowledged that the amount of effort that goes into data collection and preparation and the related costs can surprise companies that intend to work with advanced data analytics. In fact, Dr. Krishna admitted that related challenges have become the main reason why many of IBM's clients have stopped or called off AI projects.



Data-related worries are warranted. Alegion (Austin, Texas), which provides a platform for training data for AI and machine-learning applications, recently sponsored an international survey of AI professionals and data scientists. The survey revealed that some 80% of respondents said that their companies have found training algorithms more challenging than they expected. Furthermore, 96% of respondents said that their companies have encountered algorithm-training problems with data quality and data labeling and with building confidence in the model. These survey results highlight that companies often underestimate data issues—for example, collecting the right data, managing data appropriately, and labeling data correctly—that can break a project. Because of the services it offers, Alegion has interest in highlighting such data issues; however, other organizations are seeing similar shortcomings in data use.

Data-management and data-quality issues are not the only factors that organizations must take into account. The US National Security Agency (NSA; Fort Mead, Maryland) recently recommended that the White House end the surveillance program in use to collect information about phone calls and text messages that occur in the United States. The NSA cites legal challenges (such as ensuring compliance with data-collection regulations) and substantial logistical efforts as the reasons for its recommendation to end the program. Various agencies of the US government once saw the program as an important tool for use in counterterrorism activities, but the program now appears not to deliver benefits substantial enough to justify its costs and the effort it requires. According to a former senior intelligence official, “The candle is not worth the flame” (“NSA Recommends Dropping Phone-Surveillance Program,” *Wall Street Journal*, 24 April 2019; online).

The efforts that go into building up large data sets for competitive purposes might fail to result in the competitive benefits that organizations are seeking. In a recent article, Martin Casado and Peter Lauten of venture-capital firm Andreessen Horowitz (Menlo Park, California) outline that contrary to common belief, companies cannot necessarily rely on large proprietary pools of data to protect them from competitors. In many cases, the cost of acquiring and maintaining new data grows much faster than does the benefit that companies can gain from leveraging those data. Furthermore, acquiring additional data past a certain point can become very costly and yield few benefits. Apparently, little evidence supports the common assumption that gathering data leads to network effects, where large pools of data become increasingly valuable in proportion to their size. Rather, data pools manifest scale effects that typically generate diminishing returns as the data corpus grows. The authors warn that “treating data as a magical moat can misdirect founders from focusing on what’s really needed to win” (“The Empty Promise of Data Moats,” Andreessen Horowitz, 9 May 2019; online).

The use of large amounts of data has found many worthwhile target applications, but companies that are considering using large data sets for analysis or AI training should be aware that acquiring data and managing those data have costs. Often, results of big-data approaches are marginal or fail to justify their distracting from other, perhaps more important, organizational and operational activities. In addition, many factors other than logistical issues play a role in data analytics. As [SoC1085 — The Limitations of Data Analytics](#) discusses, a wide variety of human-centered factors can lead to the abandonment of data-driven approaches.

## SoC1104

### Signals of Change related to the topic:

SoC1085 — ...Data Analytics  
SoC879 — ...Working with Uncertainty  
SoC655 — Big Data, Big Concerns

### Patterns related to the topic:

P1123 — Questioning Big Data  
P0650 — Big Data's Broken Promise  
P0509 — Big-Data Pitfalls

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March 2018

SoC1003

## Living in a Predictive World

By Martin Schwirn (Send us [feedback](#).)

Highly connected networks, ever-more-powerful artificial intelligence (AI), and increasingly comprehensive databases enable researchers and practitioners to foresee a wide range of phenomena at an earlier stage now than they could in the past. Such predictive capabilities enable users to identify issues early and potentially avoid problematic outcomes. As more and more data see collection across an increasingly broad range of fields, many application areas will emerge. This Signal of Change looks at two areas that saw interesting developments in recent years—the areas are distinct but indicate how predictive analytics can find use across application areas. Early detection of medical issues and health crises can help health-care professionals address emerging health threats early. And anticipating criminal behavior can help law enforcement prevent crime or can guide strategies that address criminal developments.

In predicting health issues and identifying problematic situations, novel AI can employ as much knowledge as can human experts—or even more. Researchers at the University of Nottingham (Nottingham, England) have developed AI algorithms capable of estimating with a significant degree of accuracy the likelihood that a patient will experience a cardiovascular event such as a heart attack. The algorithms used data from the medical records of hundreds of thousands of UK patients to generate, test, and refine the predictive models they employ. Similarly, social media's expansive and diverse collection of information—including personal data, pictures, and conversations—enables service providers to identify potentially problematic behavior. For example, Facebook (Menlo Park, California) is developing AI technology capable of spotting posts and comments that suggest, for example, thoughts of self-harm or suicide.

Facebook employees can then check the posts and comments and offer ways for troubled users to seek help. The company is also leveraging the power of its massive community of service users. The suicide-prevention tools the company integrated into its Facebook Live live-streaming service enable users who notice problematic behavior and situations to connect directly with the person streaming or notify Facebook to prevent self-harming.

Government institutions can make use of predictive models to improve health-care policies and strategies more broadly. Recently, the Chicago Department of Innovation and Technology and the Chicago Department of Public Health (both Chicago, Illinois) worked together to develop a model that can predict one week in advance whether specific areas will see an emergence of mosquitos that might carry the West Nile virus. The model uses data from a previously established surveillance-and-control program to generate a score that guides health officials about where and when to conduct mosquito-spraying efforts. The ability to investigate massive databases and correlate information also offers a wide range of application opportunities that will only increase in number as databases grow in size and connect with one another. Researchers at the Washington University School of Medicine (Washington University in St. Louis; Saint Louis, Missouri) have created an algorithm capable of predicting with significant accuracy whether a patient will eventually develop Parkinson's disease. To create the algorithm, the researchers analyzed data from claims that more than 200,000 people made through the Medicare (US Department of Health and Human Services; Washington, DC) national health-care-insurance program from 2004 to 2009. The researchers then identified which

*Algorithms are  
guiding strategies  
in law enforcement.*

of these more than 200,000 people received a Parkinson's diagnosis in 2009 and which of these people did not. Using only Medicare-claims data and demographic data, the algorithm was able to identify 73% of the people who did and 83% of the people who did not receive a Parkinson's diagnosis in 2009.

New algorithms are also guiding strategies in law enforcement. Axon Enterprise (Scottsdale, Arizona)—formerly Taser International—is a leading provider of body-camera systems and other products for the law-enforcement market. Body-camera systems have seen adoption by law-enforcement agencies across the United States, and Axon is developing an AI platform capable of reading and analyzing the stream of video data coming from police officers' body-camera systems in real time. The long-term goal is to develop systems that anticipate illegal activity.

The large communities of social-media users and social-media services' ability to capture information in real time can also find use in preventing criminal behavior by identifying developing issues early. For example, a recent study by researchers at Cardiff University (Cardiff, Wales) showed that analysis of Twitter's (San Francisco, California) social network could enable detection of potentially dangerous situations before they escalate. The researchers analyzed 1.6 million tweets that people posted during the lead-up to the riots in London, England, in 2011, using event-detection algorithms to cluster tweets with similar content. The researchers found that some people started tweeting about disruptive and violent events as much as an hour before police became aware of them. Algorithms capable of flagging posts about events as people post them on social-media networks could augment the event-detection methods already in use by law-enforcement agencies. Similarly, analysis of other types of networks can highlight potential geopolitical-

crisis spots. Western Union Company (Meridian, Colorado) runs one of the world's largest money-transfer businesses. The company has developed a big-data-analytics operation that is capable of spotting impending human disasters before they reach the attention of governments. Because money transfers are highly sensitive to flows of migrants and emergencies, Western Union's ability to follow the money gives it the capacity to sense emerging challenges. Many flows of cash are remittances sent by workers living abroad to their families back home, and they constitute a stable set of flows in the Western Union network, which includes some 550,000 offices in 130 countries (many of which operate in partnership with local convenience stores, shops, and so on). When people are trying to escape from areas that are on the brink of civil war or about to experience economic collapse, remittances jump; likewise, when people escape to new places—from Syria to Greece, for example—destination countries of remittances change. Because Western Union tracks the names of senders and recipients, the amounts of money people are sending, and the destinations of money, the company collects data that it can use to warn of impending crises. For example, Western Union agents in Greece saw an uptick in transfers from and to people with Arabic-sounding names just as the Syrian and North African refugee crises were starting.

Many of the above applications just look at a causal relationship between medical information and diseases or provide real-time information that was previously unavailable. The term *predictive* therefore relates to the need to take action rather than to the development of a particular situation. Nevertheless, the use of applications that provide a head start for medical personnel, law-enforcement agents, and professionals in many other industries could make the difference between success and failure in addressing emerging issues.

## SoC1003

### Signals of Change related to the topic:

SoC920 — Halt the Epidemics!  
SoC885 — Uncertain Predictability...  
SoC857 — Guesswork Computing

### Patterns related to the topic:

P1163 — Self-Repairing Machines...  
P0913 — Certainty of Uncertainty  
P0779 — The Future of Forecasting

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SoC885

## Uncertain Predictability, Predictable Uncertainty

By Alex Soojung-Kim Pang (Send us [feedback](#).)

Under the best circumstances, professional futurists can identify only a range of possible futures and outcomes; however, experts in a variety of fields recently raised the chilling prospect that even understanding potential future developments is becoming increasingly difficult. As University of Cambridge (Cambridge, England) political economist and research fellow at the University of Sheffield's (Sheffield, England) Sheffield Political Economy Research Institute (SPERI) Helen Thompson recently put it, "In the surreal world of post-2008 financial markets and monetary policy 'black swan' events [rare and unpredictable events] shouldn't surprise us any more" ("The Coming Crisis: we're not in Kansas any more," SPERI, 25 May 2016; online). She is not alone in this assessment.

Journalist Steve LeVine, an adjunct professor in the Security Studies Program at Georgetown University (Washington, DC), looks at energy developments in the context of technology and geopolitics. LeVine notes that although global oil prices have fallen dramatically since 2014, analysts did not see the price drop coming. He also points out that analysts failed to predict that Saudi Arabia would launch a price war in response to the *shale gale*—the rise in oil production in the United States thanks to fracking and in Canada thanks to the exploitation of oil-shale reserves—attempting to use the moment to push smaller oil-producing nations such as Venezuela and Iran aside. Analysts also failed to anticipate Saudi politicians' willingness

to maintain this stance even at the cost of the nation's revenues and their willingness to lowball other countries about the magnitude of the nation's oil reserves—analysts underestimated Saudi Arabia's geopolitical resolution and its oil reserves. Such a surprise in technological developments, oil supply, and political decision making is significant because energy markets drive global economic growth, and academic economists, government policy makers, and

traders alike study them very thoroughly. Perfect oil-price forecasts have always proved elusive; however, until recently, understood models existed that economists could test and improve. Such models now appear to be in question at a fundamental level.

The financial market has seen upheaval and surprised many experts. Helen Thompson argues that because of a combination of

quantitative easing, extremely low interest rates, and high-frequency trading, finance markets now behave in ways that no one can predict. And Artemis Capital Management (Austin, Texas) managing director Christopher Cole refers to an era of postmodern finance, arguing that "we are in the greatest period of stability with the largest probabilistic tail risk ever" ("Volatility and the Allegory of the Prisoner's Dilemma: False Peace, Moral Hazard, and Shadow Convexity," Artemis Capital Management, October 2015; online). The *Financial Times* draws comparisons between Cole's interpretation of economic developments and a theory by the late Washington University in St. Louis (St. Louis, Missouri) economist Hyman

*The decreasing understanding of developments and dynamics and the deteriorating ability to anticipate them raise questions about how political and commercial actors can make rational and forward-looking decisions.*

Minsky: “As Minsky once wrote, it’s stability that proves to be the greatest source of instability. A phenomenon Cole likes to attribute to the presence of shadow convexity in the system.... There’s arguably a new scale of self-reflexivity that’s been added into the system—the mother of all feedback loops, if you will” (“The shadow convexity risk in the machine [and the VIX],” *Financial Times*, 13 October 2015; online). In addition, acquiring economic information has proved increasingly difficult. The quality of Chinese economic data from the Chinese government has lacked trustworthiness in general, and although other fast-growing economies lack the infrastructure necessary to report reliably about their economic conditions, they have numerous incentives to paint misleadingly rosy pictures. Meanwhile, sophisticated global companies have learned how to use reporting laws to their advantage to make themselves opaque. Finally, the growth of algorithmic trading has created an entire class of significant financial players that no one can understand because looking at algorithms’ assumptions and processes is intrinsically difficult. Such developments prompted successful hedge fund Nevsky Capital (London, England) to close in early 2016. The firm argues that because algorithmic trading increases volatility, the quality of data and the transparency of decision making and equity markets decreased while fat-tail risk increased.

Political instability is also increasing, and the United Kingdom’s unexpected decision to withdraw from the European Union adds the newest twist to political uncertainty. A 2016 survey of global experts by the Bertelsmann Foundation (Gütersloh, Germany) revealed a deep sense of pessimism about the future in the face of growing authoritarianism, increasing influence of sectarian religion on domestic politics and

geopolitics, and growing extreme poverty, which affects people in more countries today than it did a decade ago. As such instabilities build and feed on one another, the likelihood that extreme politicians and political movements will emerge increases, which creates dynamics that will diverge in many directions.

The foundations of economic and societal planning are also under consideration. Researchers from the University of Hamburg (Hamburg, Germany) and the University of Göttingen (Göttingen, Germany) have suggested that economic growth in Western countries is coming to an end. Whereas some economists believe GDP growth is exponential, the researchers argue that it has been linear since the 1960s. The problem, then, is that creating a constant percentage growth in GDP as the economic base continues to grow becomes impossible. The implications for government budgets and retirement funds, which assume ongoing growth of between 1% and 2% annually, are profound. A host of current political and economic theories and related decisions make sense only under the assumption of long-term economic growth for all.

The decreasing understanding of developments and dynamics and the deteriorating ability to anticipate them raise questions about how political and commercial actors can make rational and forward-looking decisions. In a world in which many regions are becoming increasingly authoritarian and antidemocratic and descending into political and economic turmoil and in which the old rules of geopolitics and standard economic frameworks seem no longer to apply, taking uncertainty into consideration more explicitly will become a strategic competence of utmost importance.

## SoC885

### Signals of Change related to the topic:

SoC753 — The Art...of Forecasting  
SoC369 — Prediction Is the Future  
SoC170 — Predictions and Behavior

### Patterns related to the topic:

P0913 — Certainty of Uncertainty  
P0779 — The Future of Forecasting  
P0678 — Mining the Future

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SoC879

## Big Data: Working with Uncertainty

By Rob Edmonds (Send us [feedback](#).)

**S**oC857 — *Guesswork Computing* points out that the outputs of most big-data systems are maybes, not definitive results. Such systems use numerical thresholds to make probabilistic judgments instead of following logical rules to arrive at certain answers like conventional software does. Problems with data and imperfect statistical models sometimes cause big-data systems to make mistakes. Organizations are evolving processes and safeguards for big-data use, but they are having mixed results.

Some analysts believe that the inherent uncertainty of big-data analysis makes it unsuitable for some applications. In reference to a National Security Agency (NSA; Fort Meade, Maryland) research project to profile potential terrorists on the basis of Pakistani mobile-phone and social-network data, computer-security expert Bruce Schneier says, “Government uses of big data are inherently different from corporate uses.... If Google [Alphabet; Mountain View, California] makes a mistake, people see an ad for a car they don’t want to buy. If the government makes a mistake, they kill innocents” (“The NSA’s SKYNET program may be killing thousands of innocent people,” *Ars Technica*, 16 February 2016; online). Documents that former NSA contractor Edward Snowden published reveal that NSA engineers trained a machine-learning algorithm to distinguish potential militant Al Qaeda couriers from the general population with data from 100,000 ordinary citizens and seven couriers. Patrick Ball, a data scientist and director of research at the Human Rights Data Analysis Group (San Francisco, California), says that seven is a very small sample size and that the inherent uncertainty of the big-data system is problematic. In particular, the system appears to

generate many false positives (innocent people flagged as terrorists). Leaked documents appear to recommend thresholds that create a false-positive rate of 0.18%. The application of that percentage to the 55 million people in Pakistan the system analyzed (according to leaked documents) would result in the mislabeling of 99,000 people as potential terrorists. The NSA research project presents far from the only example of problematic false positives. Start-up Converus (Lehi, Utah) is marketing an eye-tracking lie detector to US government agencies as a tool for rapidly screening incoming refugees. The EyeDetect device tracks users’ eye movements and pupil dilation (pupil dilation sometimes correlates with lying). Converus claims that the system is 85% accurate, which implies significant room for errors.

Such systems tend to cause harm only if users rely on them for complete decision-making automation. Leaked documents indicate that the NSA system was only a research project that never saw use in the field. Even if such a system—or a system like the one from Converus—reached field deployment, the system would likely provide only one step in a decision-making chain that involves humans. Other fields—for example, health care, oil-and-gas exploration, and engineering—that might use big-data systems in safety-critical decision making are also likely to implement human-in-the-loop safeguards. In general, the use of big-data systems that employ probabilistic reasoning is appropriate in safety-critical decision making as long as the systems are only one part of a decision-making chain that involves humans and as long as other steps in the chain account for the inherent uncertainty of big-data analysis.

Practicality issues can prevent humans from remaining in the decision-making loop.

*Some analysts believe that the inherent uncertainty of big-data analysis makes it unsuitable for some applications.*

Visual-processing software (which typically uses machine learning and probability rather than rules) plays a role in various real-time safety systems (for example, collision-avoidance systems in automobiles). Because of time constraints, such systems must make decisions without human intervention. In these cases, systems need to be very reliable; however, in reality, system designers cannot guarantee that no mistakes will occur. Despite this risk of error, such systems may still be safer than people are. Current prototypes for autonomous cars tend to make fewer mistakes than human drivers do. And humans are sometimes overconfident in their own abilities. Studies show that although many people believe they can make judgments about people on the basis of faces, software actually recognizes facial expressions in photographs better than humans do. A team comprising researchers from the University of California, San Diego, (La Jolla, California), and other universities investigated such effects for pain recognition, and a research team from the Massachusetts Institute of Technology (Cambridge, Massachusetts) looked at the perception of smiles.

Outside the realm of safety-critical applications, big-data systems suffer mixed fortunes in the quality of the processes and safeguards that support them. Some companies allow automated systems (for example, systems in use in online advertising) to make mistakes because the cost of failure is low. Other automated systems (for example, automated-trading systems) have potentially high costs of failure, but operators simply take risks. In many cases, big-data systems form part of humans-in-the-loop decision-making chains, but organizations and individuals lack the skills and processes necessary to interpret big-data results and to use the information to make decisions. In some cases, users have too much confidence in big-data results and forget that big-data systems

rely on probabilistic reasoning rather than on logical analysis. In other cases, users simply get lost in analyzing information without clear goals about how to translate the analysis into action. Big-data user Claire Suddens-Spiers of financial-services company Rothschild Group (Rothschild & Co; Paris, France) calls this phenomenon “analysis paralysis.” Surveys suggest that many organizations struggle to realize the value of big-data investments. For example, on behalf of the American Institute of Certified Public Accountants (New York, New York) and the Chartered Institute of Management Accountants (London, England), Longitude Research (London, England) surveyed 300 C-level executives across 16 countries about executive decision making. Of survey respondents, 32% said that big data had made things worse rather than better (36% thought that big data had improved matters, and the remaining 32% were neutral). About 80% of respondents said they had seen an important strategic decision go haywire in the past three years because the decision relied on flawed data.

Organizations and individuals are adjusting to the era of guesswork computing and slowly learning to implement processes that make use of computers that deliver maybes rather than definitive results. Safety-critical applications tend to use decision-making chains that involve humans (though real-time safety systems have to rely solely on software). Many regular big-data applications also use human-in-the-loop decision-making processes; however, these processes are often too vague, and individual workers lack the skills necessary to turn big-data analysis into action. As organizations learn the potential and the limits of big data, progress will likely occur. In the meantime, users of big-data systems should ensure that their processes mitigate the uncertainty of big-data results.

## SoC879

### Signals of Change related to the topic:

SoC857 — Guesswork Computing  
SoC845 — Quantified Employees  
SoC687 — Analysis via Social...Data

### Patterns related to the topic:

P0913 — Certainty of Uncertainty  
P0885 — Trust in Driverless Technology  
P0762 — Data versus Intuition

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SoC753

## The Art or Science of Forecasting

By Carl Telford ([ctelford@sbi-i.com](mailto:ctelford@sbi-i.com))

Market forecasts are extremely popular inputs for both government and commercial organizations. These forecasts provide numbers, and numbers are tools that many planners and strategists are accustomed to and can work with. Forecasts that highlight impressive market developments for emerging technologies are commonplace throughout industry publications because they justify spending and presumably provide a rationale for choosing a strategic direction. For example, a recent article on 3D-printing-news website Inside3DP ([www.inside3dp.com](http://www.inside3dp.com)) drew attention to a new report from market-research firm IDTechEx (Cambridge, England). The report predicts that the market for 3D-printing applications will grow to \$7 billion by 2015, with more than 40% of that market (\$3 billion) coming from bioprinting. One can easily infer the conclusions that managers and decision makers related to the industry will come to.

Precise but inaccurate forecasts, though, result in incorrect conclusions that lead to misguided strategies. In June 2014, the German Federal Ministry of Transport and Digital Infrastructure (Berlin, Germany) announced that it had compiled traffic forecasts for the year 2030. This development prompted journalists at German newspaper *Der Spiegel* to look at the accuracy of previous forecasts. Specifically, the journalists looked at the forecasts that researchers made for the year 2015 back in 2001. The forecasts were wildly inaccurate. The 2001 forecast predicted that the number of registered cars in Germany would reach 49.8 million in 2015. As of 2013 (the latest year for which numbers are available), only 43.3 million cars were registered in Germany. The 2001 forecasts also predicted

that 251 million passengers would pass through Germany's airports annually by 2015, but that number reached only 180.7 million by the end of 2013. Furthermore, the forecasts predicted that annual river-based freight transport would reach 88.6 billion tonne-kilometers in 2015, but by the end of 2013, that figure reached only 59.7 billion tonne-kilometers. The airline and shipping industries likely will not see the numbers the 2001 forecasts predicted by 2015. Surprisingly, many forecasts provide very precise data—for example, the 2001 forecasts provided very specific figures such as 49.8 million cars and 88.6 billion tonne-kilometers—despite the common understanding that overall forecasts are likely incorrect. The

*Organizations and industry commentators are starting to view long-term market forecasts with increased scepticism.*

article in *Der Spiegel* even cites politicians who reference the “fake precision” of forecasts.

Planners for both government and commercial organizations like market-research forecasts because numbers facilitate the creation of both policies and strategies.

Building strategies around numbers is easy. For example, if a government agency can state that a certain number of additional cars will be on the road by 2020, then it can easily justify the planning of new infrastructure. Nonnumerical forecasts likely will generate questions about quantities—“How much?” and “How many?”—to provide guidance. More often than not, forecasts are misleading (and sometimes wildly so), but a clear need for them exists. Forecast improvement is necessary, and planners must manage their expectations about the accuracy of forecasts.

Many researchers create forecasts and projections through the analysis of existing data or collections of new data they obtain from interviews with industry representatives; however, some researchers are starting to use other approaches to create forecasts. The past



decade has seen an explosion of big-data-based approaches to forecasting, but developments suggest that a great deal of additional work is still necessary to improve the accuracy of such approaches. In March 2014, professors from Northeastern University (Boston, Massachusetts) released papers that discuss the growing inaccuracy of Google's (Mountain View, California) Google Flu Trends, which predicts influenza activity by analyzing related search queries on the company's search engine. Google Flu Trends performed well initially, but it eventually began greatly overestimating flu rates. Google Flu Trends has been an exemplar of big-data-related shortcomings, and the system's issues illustrate the need for additional work to develop more accurate forecasting tools. New models are emerging. For example, Dirk Brockmann from Humboldt University of Berlin (Berlin, Germany) and Dirk Helbing from ETH Zurich (Zurich, Switzerland) created a new model of how diseases spread. The scientists believe that geographic distance between cities has less of an impact on the spread of disease than does *effective distance*—a measure of distance that takes into consideration the density of the flow of traffic between airports. The new model uses the connectedness of locations to identify the origin of an outbreak and to predict how it will spread.

Analysis of social media is another big-data-based approach seeing increasing use in forecasting and trend research, although the forecasts these analyses produce mostly address short-term developments. Indeed, the use of algorithms that sift through social-media communications has become common. Dataminr (New York, New York) analyzes the tweets on Twitter's (San Francisco, California) social network daily in efforts to identify events before mainstream media outlets pick up on them. Dataminr's customers include companies in finance, media, and the public sector. During the Boston Marathon in April 2014, authorities

used Dataminr in their strategy to prevent events similar to the terror attack that occurred during the marathon the previous year. As few as three tweets can deliver a signal strong enough that Dataminr alerts its clients, which—according to the company—get a warning of five to ten minutes. The company claims that by evaluating some 30 indicators of significance, it was able to alert its clients about the death of Osama bin Laden 23 minutes before news outlets reported on the event. Of note is that Dataminr identifies short-term developments and events that already happened but require time to become known; the use of social-media analysis to make long-term forecasts is unproven. In addition, forecasts that rely on the analysis of social media are susceptible to manipulation of social networks. A group of researchers at the Federal University of Minas Gerais (Belo Horizonte, Brazil) recently released 120 bots on Twitter's social network. The bots used heuristics that the researchers created to retweet items and generate their own posts. Although Twitter actively tries to identify and suspend bots, 69% of the researchers' bots avoided detection. This research could suggest that a new generation of intelligent bots may be able to cause significant problems for services that aim to analyze Twitter activity to measure public opinion.

Recent developments suggest that organizations and industry commentators are starting to view long-term market forecasts with increased scepticism. Can new analytical tools, algorithms, and emerging approaches enable analysts to refine their forecasts and create more accurate market data? Somewhat ironically, the answer to that question itself remains uncertain. Current evidence suggests that a great deal more research is necessary and that disruptive developments can emerge from many directions. Although technical advances are occurring, predicting the future is still art, not science.

## SoC753

### Signals of Change related to the topic:

SoC731 — Data Monopolies  
 SoC687 — Analysis via...Search-Engine Data  
 SoC669 — Hazardous Spreadsheet Analysis

### Patterns related to the topic:

P0650 — Big Data's Broken Promise  
 P0639 — The Truth Is out There  
 P0633 — Diseases' Pathways

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August 2020

**P1530**

## Tackling Tomorrow

By Martin Schwirn (Send us [feedback](#).)

**All one can know about tomorrow is that it will be different from today; the pandemic is a reminder that predicting the future is impossible.**

**Abstracts in this Pattern:**

[SC-2020-07-01-060](#) on uncertainty  
[SC-2020-07-01-051](#) on response

[SC-2020-07-01-096](#) on early warning  
[SC-2020-07-01-066](#) on opportunities

Columbia University (New York, New York) professor of humanities Mark Lilla highlights that humans have never been able to accept the reality that predicting the future is impossible. But in light of this reality, Dr. Lilla cautions people to cease making requests for pundits to predict what the world will look like when the coronavirus-disease-2019 (covid-19) pandemic ends; however, he concedes that humans—particularly decision makers—will always ask what the future will look like, because humans “are not well designed, it seems, to live in uncertainty.”

Dr. Lilla also highlights the fallacy of trusting forecasts. The issue at hand is that many decision makers (Dr. Lilla highlights politicians) take these forecasts as gospel. But wrong forecasts breed wrong decisions. Dr. Lilla points to a crucial insight: “The post-Covid future doesn’t exist. It will exist only after we have made it.” How economic participants respond to challenges and opportunities will create the dynamics that shape tomorrow. Instead of monitoring for changes and looking for new dynamics, many decision makers become overwhelmed by uncertainty

and come to believe that being reactive and responding quickly is preferable to developing a plan to move forward. In forecasts, a tendency exists to favor hard numbers (which tend to be wrong) over qualitative assessments (which can offer directional guidance). In 2011, the European Commission commissioned *Infected*—a comic book about the threat of pandemics. The comic’s narrative foresaw many of the events and issues that would occur with covid-19 not even a decade later. Clearly, decision makers failed to heed some of the warnings that this work of foresighting surfaced.

Researchers from the International Institute for Management Development (Lausanne, Switzerland) found that in tackling the covid-19 pandemic’s effects, companies’ concerns for the short term are greater than their concerns for the long term. But the researchers argue that “most crises create longer-term opportunities as well as threats because they produce rapid, sustained shifts in organizations’ external and internal environments.”

**Signals of Change related to the topic:**

[SoC1166](#) — Scenario Planning...  
[SoC1164](#) — The Pandemic’s Impacts...  
[SoC1161](#) — Scanning...Implications

**Patterns related to the topic:**

[P1494](#) — Managing Uncertainty  
[P1470](#) — Tackling Uncertainty  
[P1400](#) — Forewarned Is Forearmed

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**P1514**

## Communications under Uncertainty

 By Martin Schwirn (Send us [feedback](#).)

**Uncertainty is a part of decision-making; related communication is crucial under the current circumstances.**

**Abstracts in this Pattern:**
[SC-2020-06-03-023](#) on answers

[SC-2020-06-03-079](#) on misinformation

[SC-2020-06-03-039](#) on trust

The coronavirus-disease-2019 (covid-19) pandemic has put a spotlight on uncertainty. Uncertainty is a part of regular decision-making, but many market-research and consulting companies focus on providing detailed forecasts and timelines that offer guidance but hide uncertainties. Because of the scale and breadth of the uncertainty that the pandemic has introduced, strategic plans that saw development before the pandemic occurred are likely invalid now. *Washington Post* reporter Jena McGregor highlights that “without control or timelines, the pandemic is upending how managers think about communicating in a crisis.” And Tim Ryan, US chairman of PricewaterhouseCoopers (PricewaterhouseCoopers International; London, England), concedes that “the hardest thing is not having an answer when you’re used to having an answer—not being able to say, ‘I know when this is going to be okay.’” Always having an answer is an illusion during the best of times, but this illusion certainly has no credibility during the pandemic. Strangely, a global pandemic must occur for decision makers to admit that no clear-cut answers exist.

Additional communications challenges have emerged during the covid-19 pandemic. For example, the lack of generally accepted

knowledge about the coronavirus and covid-19 has opened a pathway for misinformation and even disinformation. Uncertainty about the virus and disease results in misinformation, and misinformation adds to the complexity of that uncertainty—a vicious cycle. Misinformation and disinformation are common in business environments, where unknown developments lead to incorrect assumptions and companies take advantage of competitors’ lack of complete understanding.

Another matter relevant to communicating under uncertainty is that multiple types of uncertainty exist. Epistemic uncertainty relates to a lack of knowledge about the past and the present, and aleatory uncertainty relates to unknowns about the future that chance, indeterminacy, and randomness create. A team of researchers at the University of Cambridge (Cambridge, England) recently investigated whether the public loses trust in experts who admit that they are unsure about their understanding of a matter. The team discovered that individuals “can handle the truth” and can deal with stated scientific uncertainty. This insight has many communications implications for emergency management and public relations in general.

**Signals of Change related to the topic:**
[SoC1154](#) — Life after...Coronavirus

[SoC879](#) — ...Working with Uncertainty

[SoC538](#) — ...Areas of Uncertainty

**Patterns related to the topic:**
[P1494](#) — Managing Uncertainty

[P1470](#) — Tackling Uncertainty

[P0913](#) — Certainty of Uncertainty

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**P1494**

## Managing Uncertainty

 By Martin Schwirn (Send us [feedback](#).)

**Humans—decision makers in particular—constantly experience uncertainty, and managing it is a challenge.**

**Abstracts in this Pattern:**
[SC-2020-04-01-019](#) on probabilities

[SC-2020-04-01-042](#) on predicting

[SC-2020-04-01-053](#) on preparing

Harvard University (Cambridge, Massachusetts) researchers Benjamin Enke and Thomas Graeber studied *cognitive uncertainty*—a term they coined to describe “people’s subjective uncertainty about what the optimal action is” (“Cognitive Uncertainty,” SSRN, 15 November 2019; online)—and found that people are sensitive to probability changes and can misjudge the effect of such changes. They showed that people who face strong uncertainty about what the best option is in a given situation compress probabilities toward a mental default of equal probabilities. Essentially, the more uncertain the decision situation, the likelier people are to use the mental concept of flipping a coin. But such a fifty-fifty chance might completely misrepresent the actual probabilities. Because of the effects of cognitive uncertainty, corporate leaders might come to very wrong conclusions when they are making very impactful decisions.

Forward-looking decision making adds challenges, because humans are quite bad at making accurate predictions about the future. Various biases hinder humans’ ability to look at potential outcomes objectively, and humans have tremendous difficulty in working with large amounts of data and developing a feeling for trends and changes that occur over long periods.

Understanding the dynamics among relevant future-determining factors poses additional problems. Susan Weinschenk, CEO of behavioral-science consultancy Team W (Edgar, Wisconsin), explains where these human limitations come from: “Most of the time, our estimates are accurate enough to keep us alive and propagating the species. If you were doing a lot of higher-level computation, you would need more brain power.” These factors contribute to corporate leaders’ making wrong choices when they are looking at uncertain environments, which are becoming increasingly common.

Humans are also reluctant to consider and prepare for outcomes that they do not want to occur. For example, although the start-up landscape in California’s Silicon Valley is famous for starting, incubating, growing, accelerating, acquiring, and even pivoting businesses, business leaders tend to ignore the fact that failure is a possibility instead of embracing uncertainty and preparing for that real—although unwelcome—possibility. *Wired* senior writer Arielle Pardes points out that because 70% of new start-ups “go out of business within five years, you might think that more of them would have plans in place for the ‘die’ scenario.”

**Signals of Change related to the topic:**
[SoC885 — Uncertain Predictability...](#)
[SoC879 — ...Working with Uncertainty](#)
[SoC753 — The Art or Science of Forecasting](#)
**Patterns related to the topic:**
[P1470 — Tackling Uncertainty](#)
[P1244 — Better Predictions](#)
[P0913 — Certainty of Uncertainty](#)

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March 2020

**P1470**

## Tackling Uncertainty

By Martin Schwirn (Send us [feedback](#).)

**Decision makers are struggling with how to address uncertainties about future commercial environments, but various potential approaches exist.**

**Abstracts in this Pattern:**

[SC-2020-02-05-045](#) on uncertainty  
[SC-2020-02-05-050](#) on disruption

[SC-2020-02-05-088](#) on foresight

*Wall Street Journal* business columnist John D. Stoll claims that “businesspeople are haunted, and sometimes paralyzed, by uncertainty. This monster, however, can be a friend.” His article summarizes some considerations about how to tackle uncertainty. For example, climate scientist Judith Curry highlights that instead of becoming paralyzed, decision makers should take small steps toward possible solutions to climate change. Stoll argues that a similar attitude works for decision makers in business environments. Berkshire Hathaway (Omaha, Nebraska) chairman and CEO Warren Buffett points out that many decision makers should not worry about uncertainty as much as they do and highlights that worthwhile projects will be worth investing in even under uncertainty.

In a recent article, PwC US (PricewaterhouseCoopers International; London, England) principals Sundar Subramanian and Anand Rao—who leads PricewaterhouseCoopers International’s global artificial-intelligence efforts—suggest building “disruptive strategic flywheels” as a source of stabilization. They view AI, deep learning, and gaming solutions as tools for gaining a handle on disruptive developments.

The authors discuss a case in which an auto manufacturer asked a consulting firm to gauge its competitive position in relation to a specific type of start-up. The consulting firm created a game that pitted the automaker against its competitors, and an AI system used data from the game to run numerous simulations that “suggested many strategic bets, option-value bets, and ‘no-regret strategies,’ or moves that made strategic and financial sense in a multitude of situations.”

An approach to understanding the uncertainties of the future that Future Today Institute (New York, New York) founder and CEO Amy Webb suggests makes use of tools that are similar to Scan™. Her recommendation is that the president of the United States should create a “Strategic Foresight Office”—a government agency that analyzes probable futures by continually assessing sources of change, identifying emerging trends, and tracking the direction and speed of changes. Webb’s concern is that although existing agencies “each marshal some aspect of a strategic foresight function, there is no entity charged to focus on strategic foresight across domains equipped with the resources to undertake a comprehensive approach.”

**Signals of Change related to the topic:**

[SoC885](#) — Uncertain Predictability...  
[SoC879](#) — Big Data: Working with Uncertainty  
[SoC753](#) — The Art or Science of Forecasting

**Patterns related to the topic:**

[P1400](#) — Forewarned Is Forearmed  
[P1244](#) — Better Predictions  
[P0913](#) — Certainty of Uncertainty

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September 2019

**P1400**

## Forewarned Is Forearmed

 By Guy Garrud (Send us [feedback](#).)

**Enhanced prediction technologies can offer important benefits for a range of complex and highly dynamic environments.**

**Abstracts in this Pattern:**
[SC-2019-08-07-045](#) on ice buildup

[SC-2019-08-07-065](#) on weather

[SC-2019-08-07-006](#) on wind turbines

[SC-2019-08-07-044](#) on power grids

[SC-2019-08-07-049](#) on quantum computing

Scientists' ability to predict the outcomes of complex interactions is improving rapidly. For example, researchers at NASA's (Washington, DC) Glenn Research Center (Cleveland, Ohio) have developed simulation software that models the movement of freezing water droplets, enabling the researchers to understand the buildup of ice on aircraft components with a high degree of accuracy. Understanding how ice builds up on aircraft components is crucial in aircraft design and is just one example of the importance of generating accurate predictions for complex systems.

However, some systems are so complex that they make accurate forecasting over long periods next to impossible. A classic example is weather forecasting. Fuqing Zhang, professor of meteorology and atmospheric science at the Pennsylvania State University (University Park, Pennsylvania), reports that current state-of-the-art systems enable high-accuracy weather predictions for five days and reasonable-accuracy weather predictions for about two weeks on average. Dr. Zhang believes that further advances could enable forecasts for an additional four or five days before reaching the limits of predictions.

Reliable predictions—even those that span relatively short periods—can be extremely useful

in a range of industries. For example, DeepMind Technologies (Alphabet; Mountain View, California) has developed a machine-learning model that predicts the energy output from wind turbines up to 36 hours in advance. This prediction offers crucial planning time for utilities companies that need to balance energy from an increasingly dynamic set of providers. Researchers from the Fraunhofer Institute for Optronics, System Technologies and Image Exploitation (Fraunhofer Society for the Advancement of Applied Research; Munich, Germany) are also looking at using AI as a tool for managing power grids, although their research has focused more on analyzing highly detailed phasor-measurement data from power grids to predict and identify disturbances and anomalies in the grids that could signal potential problems in the network.

Quantum computing may eventually play an important role in predictive systems. For example, a team comprising researchers from Griffith University (Brisbane, Australia) and Nanyang Technological University (Singapore, Singapore) have built a quantum computer that can generate a superposition of possible future states, which could eventually enable more powerful simulations of complex and dynamic models.

**Signals of Change related to the topic:**
[SoC1087 — Changes Ahead for...Simulation](#)
[SoC1085 — The Limitations of Data Analytics](#)
[SoC1057 — ...Smart Traffic Management](#)
**Patterns related to the topic:**
[P1379 — Machines' Learning to Learn](#)
[P1351 — Advanced Sensing...](#)
[P1291 — Is Understanding AI...Necessary?](#)

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August 2018

**P1244**

## Better Predictions

By Rob Edmonds ([Send us feedback.](#))

**Predictive software continues to advance; militaries, energy firms, health-care organizations, and others could benefit.**

**Abstracts in this Pattern:**

[SC-2018-07-11-088](#) on chaos

[SC-2018-07-11-059](#) on military

[SC-2018-07-11-032](#) on energy

Predictive software is advancing quickly, and some developments are surprising—even counterintuitive. Certain predictive software can apparently reveal previously obscure patterns in chaotic systems and, to a degree, predict chaos. Veteran chaos theorist Edward Ott and other scientists at the University of Maryland (College Park, Maryland) have demonstrated such software, garnering praise from other experts in chaos theory. To develop the predictive capability, researchers used past data from a chaos system to train machine-learning software in “typical” chaos patterns. Although existing methods can predict chaos evolution to a limited extent (for example, for weather forecasting), researchers say that the new machine-learning approach can predict roughly eight times further into the future than other methods can. The approach could lead to significant improvements in weather forecasting, predict heart attacks by analyzing heart patterns, and perhaps predict rogue waves and earthquakes.

Militaries are also pushing the boundaries of predictive software and helping advance the field of predictive analytics. For example, the US Department of Defense’s (Arlington County, Virginia) Defense Advanced Research Projects Agency (DARPA; Arlington, Virginia) is working

on the Collection and Monitoring via Planning for Active Situational Scenarios program, which aims to create software that tries to gauge how adversaries are responding to stimuli, discern their likely intentions, and provide decision makers with guidance about how to respond.

Academic and military research into predictive systems could aid many applications, including those in industries such as finance, health care, logistics, and scientific research; however, better predictions will be particularly welcome in the energy industry. Unpredictable renewable power makes grid balancing difficult, and energy stakeholders are investing in solutions. For example, the Australian Renewable Energy Agency (Canberra, Australia) is funding a trial by the Australian Energy Market Operator (AEMO; Melbourne, Australia) to improve its energy-output-forecasting system. During the trial, individual wind and solar farms will provide the AEMO with self-forecasts about their energy output that take into account local factors such as geography, operational conditions, and weather. By combining these forecasts with its own, the AEMO should be able to increase the accuracy of its energy-output forecasts, helping grid operators balance power supply with demand.

**Signals of Change related to the topic:**

[SoC1020](#) — ...Predictive Health Care

[SoC1003](#) — Living in a Predictive World

[SoC947](#) — Algorithmic Simulations...

**Patterns related to the topic:**

[P1198](#) — Early Detection of Health Issues

[P1136](#) — Unpredictable Artificial Intelligence

[P1123](#) — Questioning Big Data

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May 2016

P0913

## Certainty of Uncertainty

By Alex Soojung-Kim Pang ([apang@sbi-i.com](mailto:apang@sbi-i.com))

**Predictions likely will become even less accurate than they currently are. The only valid prediction is that the world is uncertain.**

**Abstracts in this Pattern:**[SC-2016-04-06-038](#) on global political risk[SC-2016-04-06-044](#) on hedge fund[SC-2016-04-06-076](#) on mercenaries

Predictions about outcomes depend on the type of phenomena under investigation. Complicated issues have many aspects for consideration and work according to known patterns. Complex issues work according to unknown patterns, and people lack a sufficient understanding of their dynamics. Complicated issues allow predictions, but complex issues inevitably produce inaccurate predictions. Recent indicators suggest that the worlds of business and politics are falling toward the complex-issues category, making accurate predictions about them impossible.

Citibank (Citigroup; New York, New York) forecasters argue that changes in the world order are making forecasting more difficult than it was in the past. As a result, tasks as diverse as developing insurance services, assessing investments, and analyzing geopolitical risk are becoming increasingly difficult, which has a negative effect on capital providers' willingness to invest and move assets around. In addition, political leaders are proving themselves unprepared for this increasingly chaotic geopolitical situation, and they will likely make the situation worse rather than better.

After looking at similar financial and political developments, hedge fund Nevsky Capital (London, England) declared the global economic situation too unstable and unpredictable for investment advising and announced that it would shut down. The growing opacity of country- and company-level economic activity and the growth of nationalist sentiment make understanding trends and making decisions difficult for investors. At the same time, algorithms, high-frequency trading, and governments that are willing to intervene in economies add dynamics that may not be economically rational but are playing a growing role in shaping markets. Hedge funds are prepared to deal with risk, but they dislike uncertainty. Nevsky Capital believes the amount of uncertainty in the world is increasing.

One disturbing response to the growing chaos is governments' increasing use of private military companies. Arguably, mercenaries play a larger role in international affairs now than they have at any other time in history. Such mercenary armies introduce additional uncertainty to the world of politics and thereby to the world of commercial activities.

**Signals of Change related to the topic:**[SoC753](#) — The Art or Science of Forecasting[SoC369](#) — Prediction Is the Future[SoC170](#) — Predictions and Behavior**Patterns related to the topic:**[P0779](#) — The Future of Forecasting[P0678](#) — Mining the Future[P0103](#) — New Predictive Tools

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**P0779**

## The Future of Forecasting

By Alex Soojung-Kim Pang ([apang@sbi-i.com](mailto:apang@sbi-i.com))

**Recent efforts show the very different ways that researchers are trying to develop foresight methods for the twenty-first century.**

**Abstracts in this Pattern:**[SC-2015-04-01-068](#) on ACE[SC-2015-04-01-036](#) on Penn[SC-2015-04-01-091](#) on Vapor

Two notable efforts investigate new forecasting approaches: the US Intelligence Advanced Research Projects Activity (IARPA; Washington, DC) Aggregative Contingent Estimation (ACE) Program and the Value at Political Risk (Vapor) model, which is the result of a collaboration between risk adviser and insurance broker Willis Group Holdings (London, England) and consultancy Oxford Analytica (Oxford, England).

IARPA's ACE Program has sought to improve forecasting of geopolitical events by exploiting recent research from the social sciences, insights from behavioral economics, and experience with prediction markets. Five teams from universities and research centers around the United States built forecasting systems, enlisted experts, and competed to provide the most accurate forecasts about events the IARPA identified as of particular interest. The winning team from the University of Pennsylvania (Penn; Philadelphia, Pennsylvania) succeeded in part because it developed a training program for team members that included education about the biases and flaws in reasoning that normally trip up forecasters, it gave team members constant

feedback about the accuracy of their previous forecasts, and it allowed team members to work in collaborative groups. The Penn team was also able to identify several attributes that make for better forecasting, including open-mindedness, general cognitive ability, and patience in assessing data.

The Vapor political-risk model pushes risk analysis and forecasting in a completely different direction. Vapor is a large simulation that aims to identify major variables in global and national events and the character of their interactions, to assign probabilities to those events, and to estimate the financial cost of various scenarios. In effect, Vapor adapts some of the tools developed by the reinsurance industry—which are concerned with quantifying the effects of phenomena such as climate change and terrorist attacks—to political-risk analysis.

Although these two efforts go in very different directions, they both explore basic questions about forecasting and challenge basic assumptions in futures. These efforts suggest that although predicting the long-term future may be impossible, accurately forecasting near-term events may be more feasible than practitioners thought it was.

**Signals of Change related to the topic:**[SoC753](#) — The Art or Science of Forecasting[SoC696](#) — Hive Mindfulness[SoC687](#) — Analysis via Social...Data**Patterns related to the topic:**[P0762](#) — Data versus Intuition[P0686](#) — Big Data Everywhere[P0678](#) — Mining the Future

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September 2014

**P0678**

## Mining the Future

By Colton Heckerl ([checkerl@sbi-i.com](mailto:checkerl@sbi-i.com))

**New data-mining methods promise to reveal information about developing events and technological advances, perhaps offering a glimpse into the future.**

### Abstracts in this Pattern:

[SC-2014-08-06-013](#) on Dataminr  
[SC-2014-08-06-024](#) on emotions

[SC-2014-08-06-033](#) on IARPA

Various industries are beginning to use social media and software to identify promising areas of development and to sift through resources, mine text, and analyze social communications to discover indicators of potential trends. Information can be mined from sources as diverse as research papers and Twitter (Twitter; San Francisco, California) posts, and discovering important bits of information even a mere ten minutes before the competition does can establish a significant advantage. Mining social-media postings can also reveal users' emotional states and even uncover information about their mental health. Companies in a variety of fields stand to benefit from these advances in data mining for the future.

Dataminr (New York, New York) has developed algorithms to analyze the tweets that people post on Twitter's social network. The algorithms analyze in excess of 500 million tweets daily, using 30 indicators of significance to find relevant news, events, and implications up to ten minutes before the mainstream media picks up on them. And researchers at the Commonwealth Scientific and Industrial Research Organisation (Canberra, Australia) and the Black Dog Institute

(Randwick, Australia), have developed software that analyzes the language and emotional content of tweets and filters the sources by location. This use of social-media mining can indicate which regions are in need of mental-health services and could have a major influence on the allocation of public-health resources.

The Intelligence Advanced Research Projects Activity (IARPA; Washington, DC), a research agency of the US Office of the Director of National Intelligence (Washington, DC), is working on the Foresight and Understanding from Scientific Exposition (FUSE) project, which aims to identify promising areas of technological development by using text mining to analyze entire research papers and patents. Another IARPA project—Forecasting Science & Technology (ForeST)—focuses on generating accurate forecasts for milestones in science and technology by crowdsourcing opinions from more than 10 000 scientists from around the world. IARPA's two projects perhaps indicate that technological and human approaches could complement one another to produce the best results.

### Signals of Change related to the topic:

[SoC741](#) — Metadata and...Anonymity  
[SoC731](#) — Data Monopolies  
[SoC729](#) — Surveillance Activities...

### Patterns related to the topic:

[P0650](#) — Big Data's Broken Promise  
[P0639](#) — The Truth Is out There  
[P0626](#) — New Levers for Market Analysis

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