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CHAPTER

Uncertainty in Strategy Research

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Abstract

Strategic decision-making invariably involves making inferences about the future, a future that cannot be fully known. While all decisions carry risk, uncertainty arises from the inability to assign probability estimates to future events and is thus a key concept within strategy. Yet, strategy scholars sometimes use the concept of uncertainty in ways that obscure, rather than clarify, what they mean. Indeed, constructs such as risk, uncertainty, volatility, complexity, ambiguity, and dynamism are often used interchangeably and without clarification of concept. In this chapter, the authors aim to provide the reader with a clarifying overview of the classical work on uncertainty in strategy research and give examples of the more recent evolution of the concept. A particular emphasis is on the relationship between uncertainty and complementary constructs. The authors illustrate some of the strategy perspectives that surround both objective and subjective uncertainty and end the overview by commenting on new sources of uncertainty.

Keywords: uncertainty, decision-making, strategy, dynamism, volatility

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Introduction

As a condition of human life, intimately linked to managerial decision-making, uncertainty is a key concept within strategy. A quick look at newspaper headlines gives us an indication of just how often we refer to the concept of uncertainty when talking about trends and how to react to them. This may be in the context of industry competition or in reference to, for example, elections, technological developments, periods of economic instability or, recently, the COVID-19 crisis, which we can be sure will fill media, boardroom discussions, journal issues, and eventually the history books for a long time to come. Academic writing mentioning the concept of uncertainty or using it as a contextual, dependent, or independent variable thus continues to be popular, with some natural spikes around times of major crises (Huff et al., 2016). What do we know, then, about uncertainty and how it is conceptualized in strategy research, and what are some of the related topics that have concerned strategy scholars over the years?

Before discussing the concept of uncertainty in strategy research, it is useful to remind ourselves of Knight's (1921) definition of it as the inability to assign probabilities to alternative futures. Risk, on the other hand, can be estimated. A close reading of Knight suggests that he viewed uncertainty furthermore as an inability to even conceive of these alternative futures (Langlois & Cosgel, 1993). Beginning with Knight's treatise on risk and uncertainty, we can illustrate how two approaches emerged: one derived from more traditional economic theories (favoring the analogy of the market as mechanistic, inspired by laws of physics) and a second derived from alternative and more cognitively oriented models (favoring the analogy of the market as organic, inspired by laws of biology and psychology).

These different traditions resulted in the 1970s and 1980s in two complementary schools of thought, treating uncertainty as either an objective characteristic of the environment or a (purely) subjective perception of the individual decision-maker (producer or buyer). While these schools have very different ontological origins, they can usefully be juxtaposed in order to understand related notions of judgment (under uncertainty) and cognitive bias (such as overconfidence). In this chapter we provide an overview of how these two schools evolved within strategy research, and how they have sometimes been directly compared.

Construct validity is a particular issue in uncertainty research. For example, constructs such as risk, uncertainty, rate of change, volatility, complexity, ambiguity, dynamism, and munificence are often used interchangeably to describe the external environment of the firm, and without much clarification by strategy scholars in their work. More recently, perhaps to overcome the confusion, some of these different constructs have even been lumped together as "VUCA," an aggregate description of an environment as volatile, uncertain, complex, and ambiguous, suggesting that these four constructs are correlated and complementary. Does such an approach necessarily solve anything? As Bennett and Lemoine (2014, p. 312) point out, "the four components of the VUCA acronym have unique meanings that should be instructive to leaders; instead, useful differences between the terms are glossed over and their value lost." In this overview we focus on uncertainty and demonstrate how some of the other mentioned constructs have been associated with uncertainty in the literature. We conclude with a short discussion of new sources of uncertainty and emerging areas of application in the link between uncertainty and strategy.

Uncertainty as a Construct

Knight's (1921) ideas of risk and uncertainty remain among the most cited in contemporary literature on uncertainty and provide a useful starting point for our discussion. In his view, the nature of the unknown can be conceptualized as a risk of the a priori kind, a risk of the statistical kind, or an uncertainty (Mousavi & Gigerenzer, 2014). A priori risk is the kind we find in a lottery or at the roulette table in a casino. Here, the decision-making process is deductive, based on probability theory that models the underlying structure of a situation. The odds of various future states can be treated as objective. We know the risks as these exist by design. Statistical risk is somewhat different and is the kind we know from estimates of correlations, based on stochastic knowledge. The decision process in this case is inductive, employing statistical inference. This is the kind of risk that has created an entire industry, namely the insurance industry. Using past information and what is known about correlations among related variables, insurers can calculate the risk (with associated standard errors) of a given event taking place, and thus price an insurance premium with some degree of accuracy.

In the context of organizational decision-making, a priori risks never truly exist as most decisions are subject to at least some degree of unpredictability and can be affected by unforeseen external factors. More common is a statistical risk. Well-structured problems for which solution goals are clear and for which there is a well-defined set of potential solutions fall into this category (Simon, 1997). Both a priori and statistical risk problems are commonly the subject of programmed decisions in the organization. Programmed decisions tend to be repetitive in nature, well defined, and procedural in their solution. They can be handled by agents following rules and routines, meaning that decision-making can be routinely delegated in the organization. Decision alternatives are easily specified, and outcomes are highly certain. An example would be deciding how to depreciate and replace capital investments. A largely rational approach to decision-making is achievable, based on having the correct data with which to analyze and solve the problem at hand (Daft et al., 2014).

Uncertainty arises in a very different type of situation in which either the probabilities of specific future outcomes cannot be estimated or not all the potential outcomes are known (Langlois & Cosgel, 1993). The results are similar whether potential outcomes are truly unidentifiable or whether decision-makers fail to identify them because they do not have the necessary information at their disposal. At the level of the individual manager, uncertainty results in estimates, based on opinions, sometimes reasoned, sometimes the subject of emotions (Bazerman & Moore, 2012). Decision-making may be heuristic and intuitive, based on the task at hand (Kahneman et al., 1982). Data analysis is exploratory. In a collective context, decisions may even generate conflict and become the outcome of social negotiations, when there is no obvious consensus of opinion (Daft et al., 2014). Simon (1997) refers to such decision problems as ill-structured.

Decision-making in this situation is usually unprogrammed and is more likely to catch the attention of managers (Daft et al., 2014), making delegation less likely in the face of uncertainty.

The reason a problem is ill-structured can be traced to at least three sets of circumstances. The first occurs when uncertainty could potentially be reduced to risk, given the right information, but has not been. In this circumstance, what could be reduced to a calculable risk is (mis)perceived by managers as uncertainty. The fact that managers are often poor informants about facts with which they ought to be familiar suggests that this circumstance may apply more often than we imagine (Mezias & Starbuck, 2003; Sund, 2016). The literature on scanning emphasizes the need for managers to collect relevant information from the environment that enables the accurate estimation of risk, putting structure to the problem at hand (Aguilar, 1967; Daft & Weick, 1984; Elenkov, 1997; Sund, 2013, 2015). For example, Daft et al. (1988) found that CEOs in high-performing firms scan more frequently and broadly in response to strategic uncertainty. More recently, scanning has been established as a dynamic capability (Danneels, 2008). The literature on intuition suggests that managers sometimes rely on intuitive judgment in these circumstances as a substitute (and often a valid one) for the information needed to reduce uncertainty to risk (Bazerman & Moore, 2012). For the knowledgeable and experienced manager, intuition allows for more rapid decision-making, without necessarily compromising decision quality (Simon, 1997; Wally & Baum, 1994).

A second circumstance for ill-structured problems is that in which various managers involved in decision-making have different and conflicting interests. For example, different managers may have different sub-goals in the organization that are not fully compatible (think of a marketing department wanting to expand advertising versus a finance department wanting to balance budgets). Conflicting goals may lead to different decision structures that are incompatible. This is a situation in which decision-making takes on a political nature (Pfeffer, 2013; Pfeffer & Salancik, 1974). Problem definition and subsequent solutions are negotiated outcomes, involving coalition building and satisficing (Cyert & March, 1992). Attempts at reducing uncertainty to risk may be blocked as this move can lead to decisions that are unattractive to some coalitions. Kaplan (2008) has documented how uncertainty opens up the possibility for new actors to gain power in the organization, by framing the environment in particular ways and promoting their chosen solutions—what she refers to as a situation of framing contests.

A third circumstance for ill-structured problems is that in which uncertainty simply cannot be reduced to risk. Such situations may be due to goals, problems, and solutions being ill-defined and thus surrounded by inherent ambiguity that cannot be solved by data. They may also be due to unclear or poorly understood technologies, or environmental data being ambiguous. High reliability organizations (HROs) are an example of this. HROs are tightly coupled and operate in environments characterized by high uncertainty and complexity (Roberts, 1990; Weick & Sutcliffe, 2011), examples being nuclear power plants and hospital emergency rooms. Another cause of difficulty in reducing uncertainty to risk could be the high turnover of decision-making participants such that there is never time to reduce the uncertainty before new decision-making agents enter the arena. Cohen et al. (1972) referred to such contexts as organized anarchies in which the garbage can model of decision-making exists. Here, problems are allowed to linger on without solutions, solutions are adopted for problems that do not exist, and actors in the process come and go.

Environmental Uncertainty

In strategy research, uncertainty has most commonly been explicitly associated with the external environment, indicating that for the organization the focus of strategy-making is traditionally linked to future states of this external environment (Bourgeois, 1980; Hoskisson et al., 1999). An important distinction in strategy research is between what we might call "objective" environmental uncertainty, in which we try to measure the state of an industry environment using measures such as rates of change or complexity, and perceived (and by definition subjective) environmental uncertainty. These have also been referred to as exogenous in the case of objective uncertainty or as endogenous in the case of perceived uncertainty (Griffin & Grote, 2020). These distinctions recognize clearly the epistemologically very different natures of these two uncertainty constructs. Where "true," "objective," or "exogenous" uncertainties relate to an objective evaluation of whether probabilities can be assigned to future states of the environment, "perceived," "subjective," or "endogenous" uncertainties concern the subjective interpretations of such uncertainty. Research measuring these two types of uncertainty conceptualization (by definition) measures two different things and is in fact based on two different epistemological stances—one objectivist, the other subjectivist.

On the one hand, the aim of measuring *objective* uncertainty is to evaluate whether uncertainty can be reduced to risk. On the other hand, the aim of measuring *perceived* uncertainty is to describe the cognition of decision-makers. Comparing the two has been attempted in several studies, and, perhaps not surprisingly, doing this has demonstrated poor correlations between the two (Downey et al., 1975; Keats & Hitt, 1988; Starbuck & Mezias, 1996; Sutcliffe, 1994; Tosi et al., 1973). Some conclude that this mismatch shows that managers have poor knowledge of the environment and are thus also poor informants on that environment (Mezias & Starbuck, 2003; Sund, 2016). This may be an oversimplification, as managers do not in practice solve problems in probability terms. Comparing objectively derived probability estimates with an individual manager's perceptions of probabilities may therefore be nonsensical.

The study of objective uncertainty tends to focus on the general level of uncertainty in an industry environment. General environmental uncertainty was (and is) a popular variable for contingency theorists. For example, environmental uncertainty has been theorized to influence manufacturing strategy (Swamidass & Newell, 1987), CEO scanning (Daft et al., 1988), organizational structure, innovation, and risk taking (Miles & Snow, 1978; Bourgeois, 1980). A single measure of the objective level of uncertainty of the environment cannot be directly derived. This is because the industry environment is a purely conceptual construct, and one that has multiple definitions. Typical definitions of the environment include: (1) the environment as a market structure; (2) the environment as a source of forces (Porter, 2008), events, and trends with which the organization must deal (Egfjord & Sund, 2020; Sund, 2016); or (3) the environment as a layered collective of actors and stakeholders engaging with the organization (Friedman & Miles, 2002), some of whom are part of a task environment and some of whom exist in a more general macroenvironment (Bourgeois, 1980). In the first conception, measuring uncertainty would involve an assessment of competition, as found, for instance, in research on hypercompetition (Lindskov et al., 2021). In the second, it would involve an evaluation of the nature of uncertainty related to particular trends (Milliken, 1990; Sund, 2013) or to aggregates of such trends. In the third, it would involve an examination of particular sectors of the environment, such as demand uncertainty or technological uncertainty (Anderson & Tushman, 2001).

If uncertainty is defined as a state of the environment in which risk cannot be estimated, then environmental uncertainty can be thought of as a binary variable, indicating simply whether data can be collected that results in a more or less accurate estimation of risk. Alternatively, and more often, the measure is an estimation of the level of difficulty in reducing uncertainty to risk, measured on a scale. As an environment contains numerous trends or factors that could each contain risks or uncertainties, any scale measure of objective environmental uncertainty would actually be an aggregate of multiple underlying measurements. Some factors may contain measurable risk, others uncertainty. Once all of those were aggregated into an overall estimation of the uncertainty of the environment, some environments would then be considered more uncertain than others. Given that identifying relevant industry factors, estimating the level of uncertainty for each, and assigning a weighting for each tends to be rather impractical, studies typically settle on proxies. Construct validity is therefore not surprisingly an important issue in objective uncertainty research. Proxy constructs such as rates of change, volatility, complexity, ambiguity, dynamism, and munificence have been used interchangeably and often without clarification by strategy scholars in this effort. More recently, perhaps to overcome the confusion of sorting out each proxy and how

they relate to each other, different proxy constructs have simply been lumped together as "VUCA"—an acronym pointing to volatility, uncertainty, complexity, and ambiguity.

An example of how various proxy constructs have been linked to uncertainty is contained in Duncan's (1972) classical 2x2 matrix, in which he suggests that it is the combination of complexity, defined as the number of elements in an environment that need to be monitored by the organization, and the rate of change of these elements that creates uncertainty. Duncan (1972, p. 313) furthermore suggests that the rate of change of the environment is the more important of these two sources of uncertainty. This conceptualization is still taught in organization theory classes today (Daft et al., 2014). Aldrich (2008) in turn describes three environmental dimensions, namely munificence, dynamism, and complexity. Munificence refers to the resource capacity of the environment, dynamism to the degree of turbulence or instability, and complexity the degree of heterogeneity of the environment. Munificence has been linked to evaluations of market structure, including to the notion of hypercompetition (Lindskov et al., 2021; McNamara et al., 2003). The assumption here is that both dynamism and low munificence are correlated with uncertainty in industry environments characterized by intensive competition (D'Aveni, 1994).

Dess and Beard (1984) also suggest that dynamism is linked to uncertainty, but they emphasize the need to distinguish between the simple rate of change and the unpredictability of change, such that it is "change that is hard to predict [...] that heightens uncertainty for key organizational members" (p. 56). All change does not lead to uncertainty, however. They argue that unpredictable turbulence (which they use as a synonym for dynamism) increases uncertainty and the need for environmental scanning, as does complexity. This interpretivist view of strategy and uncertainty is epitomized in the influential organizational sensemaking model of Daft and Weick (1984), in which they suggest that top management in the organization scan the environment for information cues that they subsequently interpret before acting on them. Milliken (1987) suggests that these three steps are linked to three separate types of uncertainty. The first is state uncertainty, which is the inability to assign probabilities to the occurrence of events (in essence the Knightian definition of uncertainty). She argues that this uncertainty is linked to scanning, just as the scanning literature indicates (Garg et al., 2003; Sund, 2013). The second type of uncertainty is effect uncertainty, the inability to assess what the effects of a future state of the environment will be on the organization. She argues that this is linked to the collective interpretation of trends. The third type of uncertainty is response uncertainty, which is uncertainty as to possible responses to an environmental change and how effective they might be. Interestingly, Bogner and Barr (2000) argue that in hypercompetitive environments, characterized by extreme uncertainty, conventional sensemaking frameworks do not work. Instead, managers in such environments must rely on a higher diversity of information, on more real-time information, on a faster decision-making process, and on experimentation, as part of their sensemaking.

On Measuring Perceived Uncertainty

The study of perceived uncertainty relies on measuring managerial perceptions of the environment, rather than any true objective state. The ontological assumption is that managers will act on their own subjective perceptions, rather than on any objective reality that the researcher could measure (Doty et al., 2006). It is these perceptions that drive decision-making; thus, to understand decisions, the researcher needs to map the cognitions of the manager (Hodgkinson et al., 2018; Huff, 1990; Sund et al., 2016). Different managers will perceive the same environment as more or less uncertain for several reasons, including differences in their tolerance for ambiguity and their experience (Downey et al., 1977).

Perceived uncertainty can relate either to the perceived general level of uncertainty in the industry environment or to perceptions of issue-specific uncertainty (Milliken, 1990; Sund, 2013, 2015). General perceived environmental uncertainty is of the type that would be associated with longer-term decisions regarding goals, organizational design, or the balancing of exploration and exploitation. For example, high uncertainty is related to greater organizational differentiation as the organization seeks to absorb this uncertainty (Daft et al., 2014; Langley, 1989; March & Simon, 1958). It is also related to a more short-term strategic goal orientation (Cyert & March, 1992).

General perceived environmental uncertainty has been measured using many different questionnaire instruments and approaches. These typically divide the environment into sectors such as suppliers, competitors, customers, and so forth (e.g., Miles & Snow, 1978). Managers are then asked to evaluate the

uncertainty of each sector. Some scales do this by asking managers to evaluate the proxies of uncertainty, for example the rate of environmental change or the degree of complexity, some ask managers to rate the predictability of changes in each sector, while some directly ask for the degree of uncertainty. Another popular distinction is between perceptions of the task environment and the broader macroenvironment (Bourgeois, 1985). Early classical studies already revealed that instruments used by scholars are not well correlated (Downey et al., 1975). Furthermore, there are demonstrated problems of validity and reliability for many of these instruments. This criticism still holds true today. For example, both the Lawrence and Lorsch (1967) scale and the Duncan (1972) scale have been found to lack reliability (Downey & Slocum, 1975; Tosi et al., 1973). Miles and Snow's (1978) widely used instrument with 22 items across 6 external environmental components (suppliers, competitors, customers, financial markets, government, and unions) has also been criticized. Notably the various environmental components are equally weighted in their instrument. However, for any organization, at any particular point in time, the strategic importance of these various components is likely to be unequal (Daft et al., 1988).

The aforementioned classical scales have been adapted for use in numerous studies, and a plethora of questionnaires can today be found in the strategy literature. This includes more qualitative approaches. For example, Kreye (2018) estimated respondents' perceived uncertainty relating to their business, technological, organizational, and relational environments by coding interviews discussing these environments. However, uncertainty was never explicitly discussed with interviewees. Ashill and Jobber (2001), on the other hand, explicitly asked a sample of marketing managers to discuss what uncertainty meant for their jobs. The answers were then contrasted with Milliken's three types of uncertainty in what could be labeled an abductive approach.

Issue-specific uncertainty, where uncertainty relates to a specific environmental change, is somewhat closer conceptually to the uncertainty that Knight (1921) or Kahneman and Tversky (1982) consider. Milliken's (1987) three uncertainty types fall under this category. The measurement of uncertainty related to specific environmental issues typically involves a different approach. For example, state uncertainty has been measured by asking managers to assign a probability estimate to a particular environmental change, and then asking the managers to indicate how certain they are of their estimate on a Likert-type scale (Milliken, 1990; Sund, 2013). For situations in which the uncertainty could be reduced to statistical risk provided the right data is available, this approach allows the researcher to estimate predictive accuracy in addition to uncertainty, allowing overconfidence (and more specifically over-precision) to be measured (Bazerman & Moore, 2012; Kahneman et al., 1982; Sund, 2016).

The study of cognitive biases has never been more popular, in large part thanks to Kahneman's (2011) book "Thinking, Fast and Slow," which did much to popularize what had until then been a somewhat niche topic, at least within strategy research. The empirical study of cognitive biases is an empirical context within which objective and subjective uncertainties are commonly compared. Overconfidence can manifest itself as over-precision, whereby a person is overconfident in the correctness of their knowledge (Kahneman et al., 1982; Kahneman, 2011). What countless studies have observed is the tendency for people to misjudge risk yet be very confident in their judgment. Under-confidence is on the other hand far less common. One explanation for over-precision bias has to do with the way we search for information in our memory. When faced with a question or problem, we tend first to conduct a rapid memory search for a possible solution. Once this has been identified, we then tend to look for information that confirms our initial judgment, filtering out information that does not. The implication is that managers tend to underestimate the degree of uncertainty surrounding their own decisions. A way to measure over-precision in a strategy context is to ask managers to assess the probabilities of environmental trends taking place (for which an objective probability estimate exists), and then asking how certain they are of their probability estimate. This yields a probability estimate that can be compared to the objective probability and a measure of issue-specific perceived uncertainty. If managers have inaccurate estimates in which they are very certain, this suggests overconfidence.

Thoughts on Implications of Uncertainty

Early work on uncertainty espoused the notion that more data leads to less uncertainty. The idea was that regular scanning, and a systematic approach to interpreting the data collected, would help reduce uncertainty to measurable and manageable risk. This same idea is contained in the concept of business intelligence, the systematic process of acquiring, analyzing, and disseminating relevant information (Lönnqvist & Pirttimäki, 2006). Looking at the evolution of scholarly work on strategy and uncertainty following the foundational work of the 1970s and early 1980s gives us some sense of how the conversation on uncertainty and related issues is evolving, in terms of our understanding of the context and the role of the manager. We conducted a rapid review of relevant journals from the Academic Journal Guide list to identify articles dealing with uncertainty and strategy from 1984 to 2019. Table 1 demonstrates first a growth and then the relative stability in the number of articles published over the last quarter of a decade.

Table 1: Persistence of publications on uncertainty

Period	Number of articles
1984–1989	3
1990–1995	14
1996–2000	25
2001–2005	28
2006–2010	24
2011–2015	28
2015–2019	35

Looking thematically across the time periods, a shift in the focus of articles emerges. Articles from the 1980s represent rather simplistic (by current understanding) responses to uncertainty. They focus on logical analysis, resource trade-offs, flexibility, and even the role of simply waiting for certainty. The managerial implications address bias, rationality, and strategic thinking (Weber, 1984; Wernerfelt, 1987; Ireland et al., 1987). They encourage us to work harder in responding to uncertainty but offer few new insights into that endeavor.

Research in the 1990s hint at moves executives make in response to uncertainty such as using strategic groups in their analyses because "managers cognitively partition their industry environment to reduce uncertainty and to cope with bounded rationality" (Peteraf & Shanley, 1997). In this period, we also see the emergence of new analytical tools such as cognitive mapping (Hodgkinson et al., 1999; Huff, 1990) and frameworks to deal with a realization that more analysis may not be useful. We thus see the discussion of managers dealing with uncertainty, trust, relationships, executive characteristics, culture, and managerial discretion, cementing a shift from the rational planning models and logic that had dominated previous decades. In short:

> At the heart of the traditional approach to strategy lies the assumption that by applying a set of powerful analytic tools, executives can predict the future of any business accurately enough to allow them to choose a clear strategic direction. But what happens when the environment is so uncertain that no amount of analysis will allow us to predict the future!
>
> (Courtney, Kirkland, & Viguerie, 1997)

The 2000s retained the character of the 1990s with a sustained emphasis on dynamic capabilities (Graetz & Smith, 2008; Pandza & Thorpe, 2009) and decentralization of planning and governance (Mangaliso, 1995; Santoro & McGill, 2005). Trust, relationships (Leifer & Mills, 1996; Luo, 2002), and culture (Wilson, 1994; Barr & Glynn, 2004) remained important themes. It was not really until the 2010s that we saw a discussion of the opportunity of inter-organizational relationships as a way of dealing with uncertainty, including open innovation (Sandulli et al., 2012), complementary relationships (Abdi & Aulakh, 2017), networks (Howard et al., 2016), and ecosystems (Dattée et al., 2018; Snihur et al., 2018). It is perhaps at this point that we truly shift from the rational planning model based on boundary and industry definitions, to approaches that embrace the complexity of networks and ecosystems, allowing numerous stakeholders to collectively deal with the uncertainties that surround the individual firm.

Recent research on uncertainty and strategy suggests that in uncertain environments incumbent firms must combine an external focus with some degree of absorptive capacity, to generate innovation (van Doorn, Heyden, & Volberda, 2017; Sund, Bogers, & Sahramaa, 2021). Teece, Peteraf, and Leih (2016) point to the importance of dynamic capabilities in ensuring the organizational agility to do so. Packard, Clark, and Klein (2017) in turn point out that in the case of innovation, the set of options open to entrepreneurial firms is often open, much like "*the proverbial block of stone ready for sculpture*" (p. 845). The expected outcome may be known in advance, such as a new design for a particular product, but a large set of options for getting there exists, with a difficulty in assessing what alternatives would be superior. They label this situation as *creative uncertainty*, which they distinguish from classical environmental uncertainty in which they consider the set of options to be closed. Newer discussions of uncertainty in its various forms thus continue to emerge.

Concluding Remarks

The aim of this overview was on the one hand to critically revisit the links between strategy and uncertainty research, and on the other to illustrate the richness of the literature. Rather than do justice to the many individual contributions to this literature, we hope to have stimulated scholars to think carefully about their use of the uncertainty construct, and the many associated constructs concerning the environment of the firm. As we write this overview of the literature on uncertainty, it is perhaps relevant to consider briefly what COVID-19 brought to all decision-makers in late 2020 and 2021, individual as well as organizational. Relevant features of the environment include the speed with which COVID took hold and became important, with overwhelming impacts on societies.

While some protective individual actions became widely recommended (handwashing, wearing masks, social distancing, vaccination), businesses were, beyond selective aid packages in some countries, left to fend for themselves against a crisis that contained state, effect, and response uncertainties all at once. This crisis is the perfect example of an unpredictable issue for which data may be flawed, incomplete, or non-existent. For some questions, certainty may not be reachable in such a context. Acting rapidly on incomplete information may be better than not acting at all (Eisenhardt, 1989). Where data can be found, pragmatic responses and experimentation can be carefully assessed to gain useful data to complement other forms of evidence. And, finally, avoiding conflicts and seeking solutions can be achieved by actively involving people throughout the organization who may hold relevant knowledge or experience, in an effort of collective reflection. Thus, for both scholars and practitioners, thinking about uncertainty, how it impacts strategic decision-making, how it can be measured, and how it can be dealt with remains an important and popular activity.

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