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Antecedents and implications of uncertainty in management

A historical perspective

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Abstract

Purpose – The purpose of this paper is to explain the antecedents of environmental uncertainty in management using a historical framework. The goal of developing passion and compassion in management practice and research cannot be achieved unless a better understanding is developed of the main challenge facing researchers and practitioners – uncertainty.

Design/methodology/approach – The antecedents of uncertainty in management are explored using a historical framework. This enables the generation of insights into the nature and use of uncertainty over the decades.

Findings – The importance of environmental uncertainty is escalating. The paper's historical, philosophical and critical view helps scholars explain and interpret uncertainty within their own research and formulate new research questions.

Originality/value – Understanding the epistemological assumptions underlying paradigms will better enable researchers and practitioners to face a future filled with uncertainty and equivocality.

Keywords Uncertainty, Risk, History, Epistemology, Black Swan, Strategy, Uncertainty management, Risk management

Paper type General review

Environmental uncertainty has been the dominant challenge facing entrepreneurs and managers for centuries. Some of the most influential scholars have identified uncertainty as the *raison d'être* of the administrative process, leading to organizational responses that buffer their technical core from this environmental uncertainty (Thompson, 1967). Even though each successive generation of managers has had to face greater amounts of environmental uncertainty than their predecessors, it would be remiss to assume that the uncertainty confronting the present generation is of the same form and merely more dynamic. Contemporary managers face unprecedented levels of environmental uncertainty and it is for this reason that we believe that it is necessary

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to engage in discourse about environmental uncertainty and how its impact on organizations can be mitigated.

Early discussions of uncertainty may be traced back to the discovery of the indeterminacy of an arrow in flight by the Hellenistic philosopher Zeno in the fifth century BC (Mangaliso, 2010). Since then, the very construct of uncertainty has evolved in the way that people have understood and experienced it. The primary challenge before organizations and their administrators throughout history has been the need to cope with uncertainty about the future. Concomitant with this challenge has been the increasing focus on and diverse definitions of uncertainty. In fact, many paradigms in strategic management have been developed or adopted from allied fields in order to provide structure and clarity to this task. Strategic behavior is unpredictable and represents an imperfect attempt to anticipate the unpredictable strategic behavior of others. The very genesis of the field of strategic management was based on the need to better enable managers to steer complex organizations through constantly changing and uncertain environments in order to reach desired outcomes. Thus, organizations have found themselves sandwiched between uncertain input and environmental conditions on the one hand and desired outputs on the other; with limited latitude to indulge in behaviors that can be termed socially responsible and caring. It is through the medium of strategic management that managers aim to align their organizations to these ever-changing and challenging environments. Von Hayek (1945) believed that economic problems arise only in consequence of change. In the absence of change, there is no need for complex decision making or for alteration in strategy. In their efforts to pass on their individual contributions to our models of strategic management, authors have populated a profuse "theory jungle" (Koontz, 1961), including concepts and propositions about uncertainty. Sustainable organizations and genuinely caring management are not achievable goals unless we understand the genesis and development of the principal problem they confront – uncertainty.

This paper aims to provide an evolutionary roadmap and critical perspective on uncertainty in the field of management. Since it is one of the primary determinants of strategy, we believe it is useful to understand uncertainty by studying its evolution within a historical framework that enables us to delineate the paradigmatic assumptions (Lamond, 2008) underlying uncertainty. For this purpose, some of the influential works in management and allied fields of study that deal with uncertainty are presented chronologically. Table I presents the categories of uncertainty, derived from the writings of various management scholars (Mangaliso, 2010).

In tracing the progression of the uncertainty construct within the field of management, we have adopted the following methodology and narrative structure. We delineated time periods along the lines utilized by Ansoff (1979). In this paper we will demonstrate that the very construct of uncertainty has undergone changes over the last century, with increased and multifaceted exposure leading to more granular conceptions of the uncertainty facing organizations. We will then discuss how the two major paradigms of Strategic Management – transaction cost economic (TCE) theory and the resource based view (RBV) – incorporate uncertainty (Coase, 1937; Bain, 1952; Williamson, 1985; Wernerfelt, 1984; Barney, 1991; Priem and Butler, 2001). We will conclude the paper with a critical analysis of the epistemological and ontological assumptions underlying uncertainty in management and how they expose us to significant social, environmental and business risks.

Authors	Basis of categorization	Categories of uncertainty
Early researchers (c. 1960s)	Locus of uncertainty	Internal, external
Duncan (1972)	Similarity in environment sectors and state of change	Simple-static, complex-static, simple-dynamic, complex-dynamic
Aldrich, *et al.* (1984)	Amount of information on environment	Attribute, population, domain
McCann and Selsky (1984)	Complexity in environment and adaptation to change	Type 1,2,3,4 and 5 (Hyper-turbulence)
Jauch and Kraft (1986)	Effect on goals	Performance, objective
Milliken (1987)	Uncertainty as a flow: understanding, effect, response	State, effect and response
Dixit *et al.* (1994)	Origins of uncertainty: Exogenous or Endogenous	Input, Internal/ External
Sutcliffe and Zaheer (1998)	Lack of knowledge of nature and stakeholders	Primary, secondary, supplier
Courtney (1999)	Amount of information on environment	Level 1,2,3 and 4
Mercer (2001)	Internal capabilities to understand uncertainty	Hidden, expected outcomes, random
De Meyer *et al.* (2002)	Amount of information on environment	Variation, foreseen, unforeseen and chaos

Table I.
Categories of uncertainty

Source: adopted from Mangaliso (2010, p. 14); originally published in *Strategic Choice Under Uncertainty* by Mzamo Mangaliso, 2010, Rowman & Littlefield Publishing Group

Ansoff (1979) constructed a historical framework using four time periods beginning with the Industrial Revolution, marked by vast socio-economic changes brought about by technological innovations like the steam engine and the Bessemer steel process. These laid the groundwork for an industrial basis of the economy marked by unified markets in countries like the United States and the United Kingdom.

Uncertainty in the Mass Production Era (1900-1930)

Following the Industrial Revolution was the phase of Mass Production, from 1900 until around 1930. The focus in this period was to consolidate the gains of the previous industrial revolution, i.e. the vast infrastructure, manufacturing innovations and unified markets. As the name suggests, firms were preoccupied with efficiency and production challenges. Competition was largely price-based with little or no need for sophisticated strategies. Exogenous uncertainties that emanated from regulation and government policy were also limited. Only extreme cases of price collusion and anti-trust behavior were penalized. For example, although the Sherman Antitrust Act was passed in 1890, its first significant large scale application took place in 1911, when the Standard Oil Corporation was sued by the US Justice Department (Letwin, 1956).

Scholars such as Taussig (1921) dealt with uncertainty within the framework of economics, specifically addressing how uncertainty leads to price fluctuations. However, in this period the appearance of uncertainty in the business literature was sporadic and infrequent. Arguably the first in depth treatment of uncertainty in the business literature came from Frank Knight (1921) in his book *Risk, Uncertainty and Profit*. Knight demarcated the notions of risk (measurable uncertainty) with uncertainty (unmeasurable in its "true" form). Knight asserted that uncertainty changes the nature of decision making as the task of deciding what to do and how to do it takes precedence over that of execution.

Uncertainty in the Mass Marketing Era (1930s-1950)

Ansoff (1979) defined the Mass Marketing era as one characterized by a shift from price based competition to one where product differentiation and marketing became a competitive advantage. As basic consumer needs became saturated, it was no longer enough to provide more of the same. This led to a shift from an internal – efficiency perspective to a more extroverted – marketing orientation. Concomitant with these changes was the emergence of the intra-firm Research and Development organization in leading firms like General Electric and Du Pont. However, adoption of the marketing perspective was not even across all industries. Some, like the producer durable industries, were laggards, and firms frequently settled for the old paradigm of production efficiency. Low technology, fast moving consumer goods saw the advent of the annual model change, which in turn generated demand for incremental product changes. Nonetheless, changes were largely evolutionary and not revolutionary. Coase (1937) in his seminal essay, "The Nature of the Firm," asserts the view that the price mechanism would be superseded as a coordinating medium by the entrepreneur in situations where transactions within a firm would be a better way of answering the key questions of "What to produce?" and "How to produce?" Uncertainty was acknowledged in terms of the key problem of which markets to target and how best to serve them.

Alchian (1950) considered two sources of uncertainty, namely, imperfect foresight and human inability to solve complex multivariable problems. These imperfect predictive and cognitive abilities put a limit on our ability to maximize profit even if we assume that optimum levels are known. Luck and what Alchian (1950, p. 214) calls "conscious adapting" play a central role in the Darwinian conception of economic systems. Alchian identifies imitation and trial and error as the two forms of conscious adaptation utilized by firms facing uncertainty. Thus the concept of uncertainty has evolved from an exogenous anomaly to a foundation of analysis. Alchian's work foreshadows the conflicting forces of environmental determinism and managerial choice that have shaded many debates within strategic management to this day (Hrebiniak and Joyce, 1985). These forces not only shape outcomes for organizations but also lead them to put their own survival and success above the well being of other stakeholders.

Uncertainty in the Post Industrial Era (1950s-Present)

From the 1950s onwards, firms have had to face increasingly unpredictable and dynamic environmental turbulence (Drucker, 1980). Ansoff (1979) proclaimed that the success of the Mass Production Era followed by the success of the Mass Marketing Era

led to a new norm for society where more is expected from firms than ever before, and where – maintaining profitability in complex and competitive environments is no longer enough. Globalization, technological innovation and scale of business put unprecedented demands on firms from outside stakeholders to be "socially responsible". In addition to the intensification of market, competitive and technology uncertainties of the previous era, regulatory and perceptual uncertainties are added, where single mistakes can cascade into disastrous business collapses. For the first time "environmental turbulence" became a normal part of business discourse. An example is the debate that took place in the *Strategic Management Journal* between those arguing for the presence of environmental turbulence and others who said it was a figment of imagination (Mintzberg, 1991; Ansoff, 1991; Goold, 1992). Not surprisingly, it is in this era that we see the most in depth and relevant treatment of the uncertainty construct within the literature of business and allied areas.

In the field of cybernetics it was Ashby (1958), through his Law of Requisite Variety, who demonstrated that desirable outcomes in the face of disturbances could only occur if the regulator had the necessary variety of responses. Penrose (1995) deals with the challenge of risk and uncertainty, in her seminal work *The Theory of the Growth of the Firm*. She differentiates between the two by noting that uncertainty refers to the entrepreneur's confidence in his/her estimates or expectations; while risk, refers to the possible outcomes of action, specifically to the loss that might be incurred if a given action is taken. She further states that the greater the risk or uncertainty, the more difficult the managerial task will be. She then concludes that the expansion plans of a firm are necessarily restricted by the capacity of management to deal with the increased problems with which they are confronted. Thus, uncertainty and risk act as limiting factors on expansion for any given level of experienced managerial services. Subjective uncertainty is the state of mind of the entrepreneur, including subjective estimates of the risk of disappointment. One of Penrose's (1995) solutions to taking on the challenge of subjective uncertainty is to invest more resources in "managerial research."

The interdependencies between organizations and their environments were emphasized by Emery and Trist (1965), who pointed out an additional source of uncertainty: the laws governing parts of the environment. The laws connecting parts of the organization to each other and the laws governing exchanges between the organization and its environment are often incommensurate with each other. Emery and Trist (1965) classify the causal texture of the organizational environment into four types: The first type is the placid, randomized environment, which is the simplest case, analogous to the classical market of economics. It is characterized by an absence of connections or interactions between parts of the environment. Local tactics are sufficient in this condition. The second type is the placid, clustered environment, which is analogous to imperfect competition. Since some environmental parts are clustered, pattern recognition is feasible thereby allowing strategies to be formulated. Success is contingent upon an organization's ability to read and match its environment. Unlike the first two static conditions, the remaining two environments are dynamic. The third type is the disturbed-reactive environments, which is similar to a market under oligopoly; a number of similar organizations are present, jostling for lucrative positions in the environment. In contrast to immediate tactics or long-term strategies, organizations are concerned with enacting an appropriate intermediate response –

operations. Emery and Trist (1965) use "operations" in the sense used by military strategists, the goal is to chose actions which will draw off the other organization. They further state that an operation consists of a planned series of tactical initiatives, calculated reactions by competition and followed by counter actions. Finally we have turbulent fields, the prototypical condition in the Post-industrial age. In this case, complexity is not only due to inter-organizational interactions but also due to environmental dynamism. These dynamic field forces result from: the large scale of organizations, which trigger complex processes and changes in the environment. They also result from interdependencies between organizations and other facets of society such as regulation and legislation; and, from the increased pace of technological change. All these factors combine to create unprecedented relevant uncertainty. Their prescription for organizations facing type 4 conditions, i.e. turbulence, is to build intra-organization cohesiveness through shared values and coordination mechanisms by adopting matrix structures.

Analytical and prescriptive approaches to uncertainty were proposed by Thompson (1967). He conceptualized complex organizations – as buffering their technical core – in order to cope with uncertainty caused by technology and the environment. Thompson's treatment of uncertainty was comprehensive. He analyzed the impact of uncertainty on individual agents, i.e. its behavioral impact. For example, see his proposition 9.1: "When the individual believes that his cause/effect resources are inadequate to the uncertainty, he will seek to evade discretion" (Thompson, 1967, p. 119).

A detailed empirical analysis of how organizational coordination mechanisms actually operate was conducted by Lawrence and Lorsch (1967). Using the framework of subsystems – systems on one axis and integration – differentiation on the other, they analyzed how organizations differed in structures, personnel attitudes (in their goal, time orientation etc) and interactions. Organizations were beginning to be viewed as active systems that actually try to bring order to their complex environments in order to cope with uncertainty. As the organization gets differentiated into basic subsystem – sales, production, R&D, it segments its surroundings into related sectors.

Akerlof (1970) looked at uncertainty caused by information asymmetries between market participants. He used the second hand car market to demonstrate the impact of quality uncertainty in distorting markets. This notion was fundamentally different from many earlier conceptions of uncertainty as an environmental feature that could not be wished away. Opportunism, adverse selection, moral hazard etc. were beginning to enter the lexicon as sources of subjective uncertainty. Interestingly, Akerlof posited that it was the ability to navigate this minefield of subjective quality uncertainty that was one of the key advantages of the merchant class in societies as diverse as Japan and America; this gave them a leg up during the transition from a merchant to manufacturing society. The post-industrial age, replete with complex market interactions, further necessitated this nuanced approach to the construct of uncertainty.

Perception of uncertainty

The subjective nature of the perceived uncertainty began to receive greater attention in the organization behavior literature during this period. Duncan (1972) conducted one of the first empirical studies on the subjective nature of organizational uncertainty along two dimensions. One dimension was anchored by the factors to be considered within

decision units, which ranged from simple to complex. The other dimension was anchored by change in the factors, which ranged from static to dynamic. Contributing empirical proof to earlier anecdotal notions, Duncan (1972) came to the conclusion that uncertainty and the degree of the complexity should not be considered as constant features in an organization but rather as dependent on the perceptions of organization members.

Tversky and Kahneman (1974, 1992) take a look at uncertainty from the lens of systematic human cognitive fallacies, such as the availability bias in which managers tend to overweigh the subjective probabilities of scenarios which are more easily recalled. Duncan's (1972) notion of the importance of subjective perception in the uncertainty construct is further complicated by Tversky and Kahneman's studies on how systematic heuristic biases distort these perceptions (Kahneman *et al.*, 1982). Organization scholar Herbert Simon (1962, 1973, 1979, 1991) emphasized the need to incorporate notions of bounded rationality and satisficing in scenarios involving decision making under uncertainty and imperfect competition. The scope of application of bounded rationality has been expanding over the last few decades as institutional complexity creates extraordinary demands on manager's ability to navigate uncharted territory while trying to align their organizations with dynamic environments. Phenomenon like subgoal identification (Simon, 1979), where decision choices are made based on subordinate goals – when organizational goals cannot be connected directly to actions – add nuance and variance to decision making that cannot be ascertained a priori, much less analyzed or predicted. Simon goes on to point out three procedures to transform intractable decision problems into tractable ones: Focus on satisficing decisions, where choices are satisfactory and not optimal; replace abstract, global goals with observable and measurable subgoals; and finally, fragment decision-making task amongst multiple specialists and coordinating their work using communications and authority.

Prescriptions for uncertainty

Miles and Snow (1978) in their seminal book *Organizational Strategy, Structure and Process*, introduce the notion of the adaptive cycle that all organizations need to traverse. Broadly, adaptive problems fall into the categories of entrepreneurial, engineering and administrative. Firms enact their environment through the strategic choices they make in any of these three problems. If the strategic changes lead to either a mismatch between these three interrelated aspects of the adaptive process or with the external environment – firms will face adaptive failure. They go on to create an organizational typology (consisting of defenders, prospectors, analyzers and reactors) based on how firms move through the adaptive cycle. Prospectors, with their constant environmental scanning are highly suited to uncertain environments but may be unable to consolidate and solidify gains made in the entrepreneurial aspect if their administrative and engineering capabilities are not up to par. Analyzers on the other hand with a more balanced approach to environmental scanning, imitation and institutionalization may be the best adapted for long-term organizational success.

The catalyst for Schendel and Hofer's (1979) volume, *Strategic Management: A New View of Business Policy and Planning*, consisting of papers from the Pittsburg conference on Business Policy, was the escalating level of environmental change – as identified by writers such as Alvin Toffler (1973). This increased uncertainty had by

the 1970s made the notion of Business Policy as a capstone course rather anachronistic and incapable of fully answering the issues that business executives were increasingly confronted with. Igor Ansoff (1979) believed that Strategy was a type of solution to a problem and that strategy arose due to a product/ technology mismatch between the firm and its newly turbulent markets. He further states that whereas the original mismatch was at the interface with the environment, today it is the interiors of many enterprises that are mismatched to the surrounding turbulence. Ansoff emphasized the need to move beyond product/market/ technology strategies to face the new realities of resource constraints, legitimacy concerns and socio-political realities. Business success was no longer enough; organizations had to develop concrete strategies to address legitimacy and social responsibility concerns. This multi-level and unpredictable turbulence led to a need to view strategy as a holistic concept rather than decision heuristics. However, the positivist approach subscribed to by Ansoff and other scholars of what came to be known as the Planning School of Strategic Management was not universally accepted. Mintzberg (1991) critiqued Ansoff's notions of environmental turbulence on the basis of the old paradox of learning vs. planning, incrementalism vs rationality and environmental determinism vs. managerial choice. Mintzberg conceptualized Emergent Strategy as a viable antidote to environmental uncertainty in a world where a priori predictions of outcomes are not possible.

Porter's (1980) approach to strategy from the industrial economics perspective leads him to view uncertainty as a byproduct of structural complexities, that could be resolved if the right information could be plugged into analytical frameworks. As one of the leading proponents of the "Positioning School", he has put forth generic models and frameworks that assume that with the proper data and analysis – the right strategic positioning could be achieved. Reduction in uncertainty is a form of learning that that makes an impact over time as issues get resolved through experimentation and experience. However, reduced uncertainty can become an impetus for new entrants to attack the incumbent firm. In emerging industries, uncertainty takes the form of either technological uncertainty about product configurations that will ultimately prove successful; or strategic uncertainty involving incomplete information or ambiguity about the "right" strategy.

Shift towards subjectivism

The notions of uncertainty, categorized as four types of causal texture of the organizational environment by Emery and Trist (1965), were further refined and linked to the notions of subjective perception of uncertainty by the management scholars McCann and Selsky (1984). They posited that escalating scale and density of interactions combine with unpredictable innovations to create turbulence. The "relevant uncertainty" of Emery and Trist (1965) becomes an issue when an organization's skills and resources are unable to cope with it. Thus, adaptive capacity becomes the primary moderator of the environmental uncertainty facing an organization. Resources and skills at the disposal of members constitute this adaptive capacity. Emery and Trist (1965) proposed that perceptions of subjective uncertainty are therefore linked not to environmental complexity in itself but to the level of these changes relative to an organization's adaptive capacity. Furthermore, due to interdependencies, this adaptive capacity was also reliant on the whole ecosystem on which a particular member was dependent. Going beyond the Emery and Trist (1965)

typology, McCann and Selsky (1984) believed that due to limits to collaboration as witnessed in – competitive behavior, hedging, value conflicts, historical antagonisms etc – members will begin to search for adaptive alternatives in times of great uncertainty. Turbulence in this transitional period becomes endemic and causes frequent organizational failure and collapse. These are Type 5 or Hyperturbulent environments. McCann and Selsky proposed a bleak outcome in these situations – they conjecture that partitioning will occur between Type 4 environments and Hyperturbulence as members try to segment and allocate the limited adaptive capacity. Any concerns about the well being of stakeholders will atrophy in these Hyperturbulent environments as members fight for survival.

Milliken (1987) took a critical look at the "Uncertainty" construct and past research in the field from the methodological perspective. She gave a credible critique of past measures of perceived environmental uncertainty and claimed that the lack of convergence between different measures of uncertainty (Lawrence and Lorsch, 1967; Duncan, 1972 etc) was due to their scale construction in addition to the probable explanation that they measured different aspects of environmental uncertainty. Milliken also put forth her categorization of the three types of perceived environmental uncertainty: state, effect and response. The first type is state uncertainty, which is defined as the inability to assign probabilities to states of nature, is the closest to perceived environmental uncertainty. The second type is effect uncertainty, defined as the lack of knowledge about cause-effect relationships. Finally, there is response uncertainty, which is the inability to predict outcomes of managerial action. Understanding this fragmented nature of perceived uncertainty, according to Milliken, was the key to clarify the confusing results of past research. Clearly if the nature of perceived uncertainty itself is multifaceted, trying to lasso a slippery construct like environmental uncertainty will fail if the measures are unreliable. Additionally, Milliken emphasizes the need to take a process view of uncertainty coping mechanisms used by administrators. It is no longer sufficient to view uncertainty as a variable to be discovered and plugged into existing decision models. The versatile nature of uncertainty leads to a greater need to understand the reflexive processes involved in its recognition and resolution. Decisions, even well-intentioned ones, may have adverse consequences when state, effect and response uncertainties are opaque.

As is apparent from our historiography until now, the uncertainty construct has undergone many refinements throughout the past few decades. More nuanced and subjective approaches have been applied as old positivist notions have been proven ineffective and inadequate. Further advancements along these lines were contributed by Daft and Weick (1984); they posited that organizations are interpretation systems, which scan the environment, interpret the data collected and finally act on what they have learned. Daft and Weick (1984) created a typology of four interpretation modes by using a two-dimensional model of organizational interpretation with assumptions about the environment on one axis being pitted against organizational intrusiveness on the other axis. Organizations were categorized as assuming the environment to be either analyzable or un-analyzable, i.e. firms have either a functionalist-objectivist worldview or an interpretive-subjectivist worldview. The second dimension of organizational intrusiveness, divided into active intrusiveness and passive intrusiveness, considered the degree to which organizations intruded into their environments. Interestingly, unlike most previous scholars, Daft and Weick (1984)

consider organizational interpretations of the environment rather than the interpretations made by individuals (Lawrence and Lorsch, 1967) or those made by decision units (Duncan, 1972). This critical difference was based on a key assumption that individuals are transitory while organizational interpretations and learning are more long lasting. Based on the two dimensions, Daft and Weick (1984) proposed four types of organizational interpretation modes and linked them to Miles and Snow's (1978) strategic types. The first interpretation mode is enacting, where the analyzable environment is coupled with active intrusiveness. This is the equivalent of Miles and Snow's prospectors. The second interpretation mode is discovering in which analyzable environment combines with passive intrusiveness. This is equivalent to Miles and Snow's analyzers. Third we have undirected viewing, in which un-analyzable environment and passive intrusiveness are joined. These are Miles and Snow's reactors. Finally, we have conditioned viewing in which analyzable environment pairs with passive intrusiveness. This is equivalent to Miles and Snow's defenders. Daft and Weick (1984) believed that depending on their interpretive modes, organizations would differ in their scanning and sensemaking processes, et sequitur that almost all other organizational activities and results are contingent upon the interpretations that result from these processes.

The notions of organizations as interpretation modes were further developed by Daft and Lengel (1986). They fine-tuned the earlier conceptualization of uncertainty by differentiating it from equivocality, defined as ambiguity. Thus, organizations face two information contingencies: uncertainty, i.e. lack of information and equivocality, multiple interpretations of the available information. This double challenge of uncertainty and equivocality reduction implies that merely having the appropriate information systems and structural mechanisms – like the integrative devices in Lawrence and Lorsch (1967) – are not sufficient, since more data/information may reduce uncertainty but is unlikely to impact equivocality. Data collection needs to be followed by debate, clarification and enactment. Daft and Lengel (1986) propose that situations with high equivocality demand communication that is information rich, i.e. provides multiple cues and inputs such as face to face meetings.

During the 1980s, although many scholars were beginning to look at uncertainty through an interpretive and process lens, objectivist approaches were not absent. Wernerfelt and Karnani (1987) highlighted the twin tradeoffs that are part of strategic decision making under uncertainty: swift decision making vs deferral – the temporal dimension; and focused investment vs diversification/flexibility, the resource allocation dimension. These are segmented into three strategies: wait/deferral, focus and flexibility. They applied a game theoretic perspective in their model and put forth the following typology of uncertainty: Demand uncertainty, Supply uncertainty – either exogenous or endogenous; and Competitive uncertainty and externalities. Based on these factors, they proposed (Wernerfelt and Karnani, 1987, pp. 189-190) that, ceteris paribus, low risk aversion, ability to influence the way the uncertainty is resolved, many first mover advantages, many economies of scale and presence of many competitors will combine to skew the strategic decision in favor of swift action and focused investments.

Learning-based views of uncertainty

As we saw in the research of McCann and Selsky (1984), perceived uncertainty was beginning to be viewed as a relative phenomenon that was dependent upon the adaptive capacity of organizations. This line of research was taken forward by Cohen and Levinthal (1990) in their seminal paper on absorptive capacity. The ability to exploit external knowledge is a function of prior relevant knowledge and confers on the firm an ability to recognize the value of new information, assimilate it and apply it for commercial goals: this assortment of capabilities is labeled absorptive capacity. Two by-products of this notion are: learning is cumulative and that diversity of knowledge plays an important role. The latter notion of diversity becomes critical in uncertain situations as it provides much needed flexibility through increased absorptive capacity. Levinthal and Cohen conjecture that firms trying to increase absorptive capacity by buying it – new personnel, consultants or acquisitions – may face disappointment as much of this capacity is firm specific, rooted in products and process innovations. The downside of absorptive capacity is that under conditions of uncertainty, it may bias a firms environmental scanning efforts and create a path dependence due to prior knowledge that may be impossible for the organization to escape. This may lead to situations were a firm faces "lockout" – precluding it from capitalizing on fast moving and potentially lucrative new market segments or industries. These ideas can be linked to the works of earlier scholars such as Miles and Snow (1978) and Daft and Weick (1984): firms with high absorptive capacity will be proactive in searching for new opportunities, analogous to prospectors (who enact their environment). Organizations at the other end of the spectrum will have a more passive approach to organizational intrusion like reactors and defenders.

The increased emphasis on learning and knowledge perspectives in the face of uncertainty continued to receive scholarly attention well into the 1990s. March (1991) focused on the dichotomy of organizational Exploration and Exploitation. He claimed that Exploration is a vulnerable condition due to the fact that returns from it are far more uncertain, hence firms are always one step away from abandoning it in favor of exploitation. This tradeoff between Exploration and Exploitation involves conflicts between gains to collective versus individual knowledge and long-run versus short-run concerns. A key feature of March's Model of Mutual Learning is that individuals modify their beliefs as a result of socialization; juxtaposed with findings on the importance of diversity for building absorptive capacity and empirical research – March concludes that heterogeneous populations consistently produce higher equilibrium knowledge and that rapid socialization of individuals into organizations tends to reduce exploration. These effects are exacerbated under conditions of exogenous environmental turbulence; as organizational and individual beliefs converge – possibilities of improvement in either decline. Furthermore, this organizational "degeneracy" in turbulent conditions can be avoided if a moderate rate of personnel turnover is present; however, this positive effect of turnover is present only if new recruits are not closer to the organizations code and beliefs.

Levinthal and March (1993) focus on the process and impact of organizational learning. They posit that by simplifying experience and specializing adaptive responses to the environment – learning may improve firm performance – however, these same mechanisms carry the downside risk of exacerbating organizational inertia. They further point out that the two antagonistic approaches that an organization can

follow: exploitation and exploration are mutually exclusive leading to either "the failure trap" where exploration drives out exploitation or "the success trap" where exploitation drives out exploration. In both cases organizations are faced with the challenge of maintaining a balance between these two states. Furthermore, Levinthal and March (1993) propose that the three grand problems of decision making: ignorance, conflict and ambiguity – are all in fact different facets of uncertainty and the inability to deal with it optimally. This implies that attempts by organizations at social responsibility and genuine concern for all stakeholders cannot be implemented unless better coping and enacting mechanisms are developed which are robust enough in the face of uncertainty.

Uncertainty in transaction cost economics

Scholars like Dequech (2006) have analyzed the uncertainty construct within the perspective of transaction cost economics (TCE) by juxtaposing it with its treatment within the broader field of new institutional economics (NIE). Dequech (2006) posits that the NIE literature deals with following forms of information contingencies: ambiguity, i.e. equivocality. Fundamental uncertainty is characterized by the possibility of creative and non-predetermined structural change, which leads to a condition without path dependence – hence, it is a situation where outcomes are unknowable in advance. Substantive uncertainty is concerned with lack of pertinent information that would be required to make decisions with required outcomes. In contrast, Dequech (2006) defines procedural uncertainty as that arising from human cognitive limitations, i.e. bounded rationality. The final distinction is made between strong and weak uncertainty; the former is characterized by the absence of unique, additive and fully reliable probability distributions.

Transaction cost economics uses the transaction as the unit of analysis. Its genesis is widely considered to be Coase's (1937) essay. Dequech's (2006) analysis is apposite as he has accurately noted that Williamson (1979, 1981, 1985 and 1999) incorporated uncertainty as one of the characteristics of transactions. However, the underlying behavioral assumption of bounded rationality seems to perfectly encapsulate Williamson's conception of uncertainty as his primary focus is procedural uncertainty. It is likely that for Williamson, complexity rather than the unknowable nature of reality are the key information contingencies. Williamson (1985) mentions notions of fundamental uncertainty in passing, for example when he refers to what would make contingencies unforeseeable – these, however, are presented as the cause of incompleteness of complex contracts. Williamson (1999) has stated that as transactions have higher degrees of asset specificity and as added uncertainty poses greater needs for cooperative adaptation, TCE would forecast transactions being brought within the firm and out of the market. In an earlier work, Williamson (1981) encapsulates the impact of uncertainty on organizational development and makes the assertion that hierarchical organizations and associated controls are traced to the bounded rationality of administrators. The organization is essentially viewed as a "problem-facing" and "problem-solving" entity (Thompson, 1967, p. 9).

Uncertainty in the resource based view

The Theory of the Growth of the Firm by Penrose (1995), which envisions the firm as a set of broad resources, is considered to be one of the antecedents to the resource based

view (RBV). Subsequent works by others have looked in more detail at the implications (Wernerfelt, 1984; Barney, 1991; Priem and Butler, 2001). Wernerfelt (1984) highlighted the paradoxical choice of exploration vs exploitation in the quest to achieve optimal growth in a firm. Uncertainty may not make multibusiness (versatile) resources more valuable as there is a commensurate increase in competition for them. Barney (1991) focused on positioning the resource based view relative to – the Structure Conduct Performance – paradigms. This invariably led to a positivist approach to strategy, which treats uncertainty not as fundamental in nature but as information contingency which can be overcome. There are fundamental differences between TCE and RBV. For example, while the former is largely concerned with firm rents through building of resource portfolios that create resource position barriers for competition; the latter is concerned with the theory of existence of the firm with opportunism playing a central role (Wernerfelt, 1984). However, both paradigms are similar in respect to their assuming away of fundamental uncertainty.

Discussion and conclusion: paradigms, perceptions and risk

The historical perspective on uncertainty highlights the critical impact of underlying paradigmatic assumptions on both theoretical and empirical scholarship. We turn our attention now to this debate. Burrell and Morgan (1979) proffered that behind all social science research are fundamental assumptions about the nature of knowledge and society. These assumptions may be implicit or explicit. The axes of their two-dimensional schema are nature of society and nature of knowledge. The nature of society axis is bifurcated into regulation and radical change, and nature of knowledge axis is partitioned into subjective and objective category. The resultant schema consisting of four paradigms labeled which have become known as the functionalist, interpretive, radical structuralist, and radical humanist paradigms as depicted in Figure 1.

Each of the paradigms will have a unique understanding of uncertainty and way of dealing with it. For instance, under the functionalist paradigm uncertainty is assumed to be an objective phenomenon, and the key issue thus becomes how this "objectively" reported uncertainty-inducing information impacts decision-making flexibility. The conceptual lens that is appropriate in this paradigm may be the contingency theory (Thompson, 1967; Lawrence and Lorsch, 1967), and systems theories (Ashby, 1956; Von Bertalanffy, 1968). In a similar manner, under the interpretive paradigm the key issue might be how the cultural norms, myths, and symbols influence the manner in which uncertainty is interpreted. The appropriate conceptual lens in this case would be hermeneutics (Giddens, 1982) and symbolic interactionism (Blumer, 1969). In the radical structurist paradigm the key question might be how the conception of uncertainty becomes rationalized to reinforce existing power disparities and asymmetries in favor of those in power. Here the appropriate conceptual lens is the Marxist (Marx, 1977) or radical Weberian (Webber, 1930, 1947) lens. Finally, the radical humanist paradigm would pry into the conditions under which decision-makers accept uncertainty as a given and the reason that cause them to accept it as such, and such an inquiry can be best conducted through the conceptual prism of critical theory (Boje and Winsor, 1993; Levy *et al.*, 2003).

Incorporated in this schema were assumptions about epistemology – proof of existence of what is considered to be real; ontology – shared understandings about

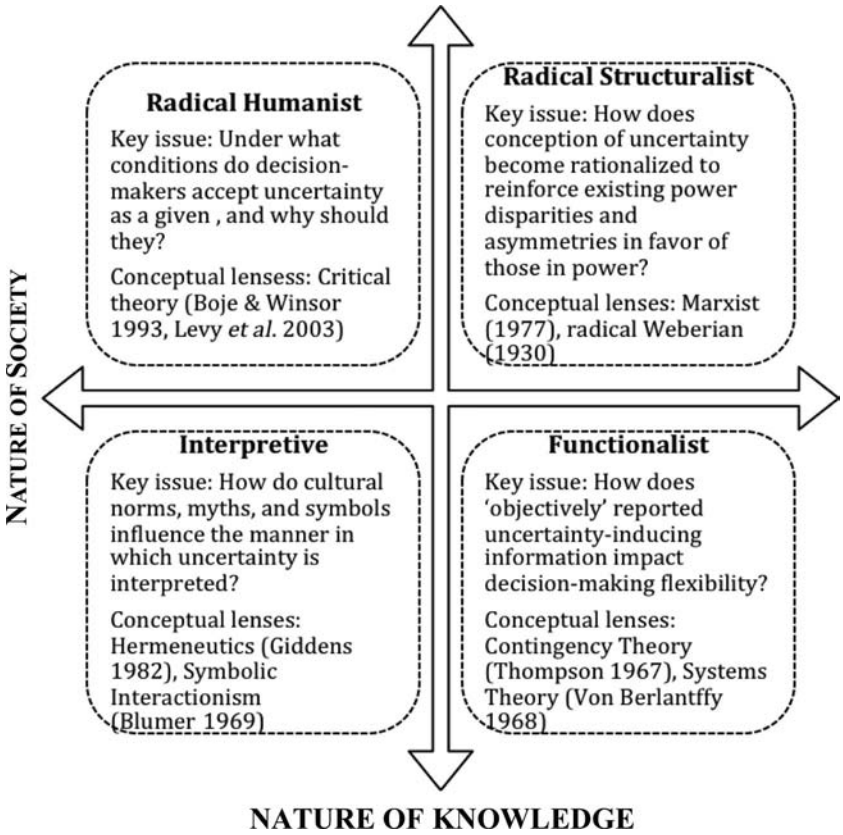

Figure 1.
Schools of thought for dealing with uncertainty

what is believed to exist; human nature; and methodology (Burrell and Morgan, 1979). A scholar's vantage point along this continuum determines his or her viewpoints about fundamental constructs. It is our contention that the construct of environmental uncertainty in management has evolved in response to two complementary and reflexive forces: first and foremost has been the increasing complexity and intensity of information contingencies facing firms. This exogenous factor has been reflected in developments in research and academia that have allowed a more fine-grained approach to uncertainty both methodologically and ideologically (Smircich and Stubbart, 1985). As scholars have taken more subjective-interpretive approaches to uncertainty, spare rigor has been replaced with nuanced richness. However, the control-driven need for positivist metrics has on numerous occasions led scholars and practitioners alike to propose prescriptive approaches that ignore the underlying epistemological assumptions and underestimate this inherent complexity in organizational and economic life. These metrics fail to be requisitely complex.

Implications of these underlying paradigmatic assumptions are not limited to academia but also greatly influence both managerial decision-making and government policy. Von Mises (1963) posited a distinction between class probabilities and case probabilities. Class probabilities are instances of probability, usually in the natural

sciences, where we know with regard to the problem concerned everything about the behavior of a whole class of events or phenomena, and can safely generalize to singular events that we know belong to that class. Case probabilities, on the other hand, are phenomena involving humans which may or may not be reducible to specific classes and hence need to be treated as unique events. Apodictic certainty is only attainable in systems where class probabilities underlie phenomena and are known a priori. These exclude all economic systems. Taleb (2007) took this differentiation of domains further by distinguishing between Mediocristan, the domain of Gaussian – bell curve – probabilities and Extremistan, where unexpected outcomes dominate. Confusing these domains, and consequently applying decision heuristics and strategies applicable in Mediocristan to environments belonging to Extremistan, is one of the key factors behind the recent financial meltdown (Taleb, 2007). Positivist approaches to management, dependent on historical data, are bound to fail in many cases, as statistical data about economic events are historical. They can tell us what happened, not what will happen, i.e. case not class probabilities (Von Mises, 1963; Taleb, 2007). Such fundamental epistemological mistakes compromise an organization's ability to adapt and survive when environmental turbulence exceeds certain threshold levels. In these hyperturbulent environments (McCann and Selsky, 1984), organizations will not only lack any excess resource slack to deal with considerations of social responsibility, they may not even have any buffer resources or capabilities' remaining to survive until the turbulence is reduced.

The tug of war for resources, between the competitive need for speed and efficiency and the uncertainty-coping mechanisms of deliberation and buffering, present a significant challenge to organizations and a risk to society at large. Perrow (1999a, 1999b) takes a look at the catastrophic aspects of uncertainty. His Normal Accident theory states that tight coupling and complex interactions combine to create "incomprehensible" accidents that cannot be forecast. "Failures ... can interact with other failures, and thus be a source of system accidents (Perrow, 1999a, p. 35)." He also goes on to state (Perrow, 1999b, p. 151): "Large systems that grow by accretion and acquisition have unplanned characteristics that one may be unaware of and that allow for the unexpected interactions of failures." Echoing Thompson (1967), he claims that multidivisional firms often fail to create adequate buffers between divisions, thereby creating tight coupling for the sake of economies of scale (Thompson, 1967). Perrow (1997) also looks at the impact of institutional inertia on environmental destruction, which is the legacy of organizational structures, which were designed not to encourage change but to maintain the status quo. The recent financial crisis which began with the subprime mortgage meltdown was but the finance industry's version of Perrow's "normal accident". Complex interactions add to the uncertainty facing organizations, while tight coupling – across the business ecosystem – reduces margin of safety and available response time. Hence, organizations are faced with a multi-faceted and paradoxical goal of being competitive in a global, complex and tightly coupled economy while running an organization that successfully meets the demands and expectations of all stakeholders.

As we saw with Ansoff's (1979) timeline, increasing technological innovation and unified markets confront organizations with unprecedented uncertainty. Global communication networks and cheap computing have multiplied the flux of information and capital flows that add to the two information contingencies facing firms:

uncertainty and equivocality. However, any attempts to meet these challenges without a clear understanding of the underlying assumptions behind strategies and their suitability to the organization's environment are bound to result in disappointment at best and disaster at worst. The goal of developing twenty-first century organizations that meet the expectations of all their stakeholders cannot be achieved without understanding the key constraint these organizations face – namely, uncertainty. The conclusion of extensive scholarship is to further challenge scholars of management to incorporate complex constructs of environmental uncertainty within their frameworks while being responsible for the key assumptions being made about the nature of knowledge and society itself.

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