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**Dynamic Capabilities and Organizational Agility:
Risk, Uncertainty and Entrepreneurial Management in the Innovation Economy**

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ABSTRACT

“Organizational agility” is often treated as an immutable quality, where it is implied that firms need to be in a constant state of transformation. But such advice ignores that changes and transformations, while often essential, come with a cost, are not always necessary, and may not even be possible. Our approach is to explore agility at a more fundamental level and relate it more specifically to dynamic capabilities. We find it essential to first understand deep uncertainty, which is ubiquitous in the innovation economy. It is very different from risk, which can be managed using traditional tools and approaches. Strong dynamic capabilities are necessary for fostering the organizational agility necessary to address deep uncertainty, such as that generated by innovation and the associated dynamic competition.

We explore the mechanisms by which managers may calibrate the required level of organizational agility, deliver it cost effectively, and relate it to strategy. We provide a set of principles and practices that differ according to whether a firm is managing regular risk or deep uncertainty. These distinctions are critical, as the mistaken use of risk management tools in an environment of deep uncertainty can bring false comfort. Our approach embraces concepts from both financial economics (e.g., hedging and real options) and strategic management theory (e.g., managerial/entrepreneurial asset orchestration). We conclude that strong dynamic capabilities are essential when firms face deep uncertainty, which they frequently do in interdependent economies experiencing rapid technological change and financial disruption.

1. Introduction

This paper brings together under the rubric of the dynamic capabilities framework a multidisciplinary perspective on the management of risk and uncertainty. Deep uncertainty is ubiquitous in connected interdependent economies experiencing rapid technological change. We harness economic and financial concepts and tools, along with insights from organization and management theory, to illuminate contexts where maintaining organizational agility is worthwhile and possibly a necessity. This conceptual integration has not hitherto been accomplished. As a result, managers are sometimes delivered a confusing amount of ill-considered advice on organizational agility. We probe issues at a fundamental level to help provide substance to advice given to firms facing uncertain and turbulent environments.

We begin with the definitions of key terms and then explain how strong dynamic capabilities can enable an enterprise under entrepreneurial management to (1) manage deep uncertainty better and (2) reduce the need for agility by buffering the enterprise using financial instruments. When agility is needed, we discuss how to achieve a more favorable outcome with respect to the tradeoff between organizational agility (or flexibility) and efficiency. We offer some guidance as to how to differentiate between risk and uncertainty and how entrepreneurial managers can improve their effectiveness at managing the

agility/efficiency tradeoff and guiding the enterprise under conditions of risk and uncertainty. We conclude with a discussion of the relationship between organizational agility and strategy.

Many treatments of agility (or the equivalent term, flexibility) in the management literature would seem to suggest that business firms should doggedly seek to become agile no matter the cost, keeping options open all the time, maintaining redundancy at all times, and staying in a constant state of radical transformation.¹ Hamel is sometimes representative of this view, claiming not only that “the goal is a company where revolutionary change happens in lightning quick evolutionary steps,”² but also that the fundamental challenge companies’ face requires reinvention continuously, and not just in times of crisis.³ We suggest that when inflexion points emerge, uncertainty is enhanced, and change is necessary for firms to remain competitive. However, because change is costly and achieving agility often involves sacrificing efficiency, one cannot assert that business firms should organize continuously for agility. Knowing when (and how much) agility is needed and being able to deliver it cost effectively is a crucial managerial capability.

Firms possessing what we define below as strong dynamic capabilities are characterized by highly effective entrepreneurial management teams and robust organizational designs. We explore the mechanisms by which such firms may be able to lower the costs (and risks) of providing a key feature of organizational agility: the ability to successfully manage uncertainty. While the efficiency–flexibility tradeoff may never be eliminated, organizations with superior dynamic capabilities will know when to sacrifice efficiency for agility, and they should also be able to obtain more favorable agility/efficiency tradeoffs.

2. Managing Risk (“Known Probabilities”)

Risk is associated with known outcomes where the probability of reoccurrences is well calibrated. Uncertainty is about unknown unknowns. Managing risk has very different requirements from managing uncertainty. The latter is more serious and a common challenge in economies experiencing innovation change.

Companies can allocate resources and adjust their activities to reduce risk with “natural” hedges. The simplest example is when, in order to ameliorate exchange rate risk, a multinational enterprise (MNE) has offshore subsidiaries and purchases (or manufactures) all inputs for the subsidiary in the offshore economy; and all sales from the facility are made in the offshore economy, competing against indigenous firms in that host country. By structuring its operations in this manner, the MNE might insulate itself from exchange rate risk. However, in so doing, the MNE might also deny itself opportunities and incur other risks. Opportunity costs stem from the fact that exchange rate changes can go both in one’s favor and to one’s disadvantage.

The amount of financial risk that a company faces is partly a function of its business environment, its balance sheet, and the nature of its loan covenants. For example, other things equal, a leveraged enterprise with variable interest-rate debt will need more cash-flow flexibility than an equally highly leveraged enterprise with fixed interest-rate debt. The nature and form of loan covenants likewise have major implications for how agile the enterprise must be to avoid default.

Risk today is easier than ever to manage because of the development of financial markets—in particular, the availability of complex securities. For example, exchange rate risk can be hedged through forward contracts and other arrangements.⁴ If markets were complete, the firm could, in theory, achieve whatever level of risk it desires—what Arrow has called “optimal allocation of risk bearing.”⁵

In short, a great deal of risk can, for a price, be contracted away, and organizational agility need not be part of the risk management apparatus. Airlines can hedge against fuel price increases without necessarily making operational changes such as temporarily mothballing less fuel-efficient aircraft or cutting flights. In some countries, wage costs can likewise be hedged for a time with binding wage agreements between firms and unions. Known cyber risk can be managed by investment in cyber resilience. Risk management procedures and protocols can also be introduced to help manage known unknowns. Contractual arrangements that offload risk to partners or suppliers or insurance companies are also possible. For instance, next-generation jet engines (and sometimes aircraft) are often developed with partners, where the development partners accept the commercial risk associated with designing and

manufacturing subsystems/parts. It is not uncommon for the “co-developer” to agree that payment for parts/subsystems is contingent upon the sale of the final assembled product (an aircraft) into which the subsystem (in this case, the engine) is embedded.⁶ Risk-sharing arrangements (e.g., contractually distributed risk) reduce the need for working capital and other forms of financial buffers for the focal firm.

3. Managing under deep uncertainty (“Unknown unknowns”)

Nearly a century ago, Frank Knight recognized that:

With uncertainty present, doing things, the actual execution of activity, becomes in a real sense a secondary part of life; the primary problem or function is deciding what to do and how to do it.⁷

In other words, under uncertainty, doing the right things is more important than doing things right (i.e., operational efficiency). However, it’s hard to do the right things when facing a wall of unknown unknowns. One cannot insure against unknown unknowns. Doing the right things under deep uncertainty requires entrepreneurial management. William Janeway recently noted that: “The innovation economy... is saturated in unquantifiable uncertainty” (p. 58).⁸

The implications for managers are far reaching but not entirely new. We note that uncertainty has always been a feature of the business environment, but the tempo of surprises seems to be on the uptick. Janeway also notes that: “a market mechanism for hedging the sort of ontological uncertainty that proliferate where entrepreneurial innovation meets emerging market opportunity has never existed, is unlikely to ever exist, and will not persist if someone is foolish enough to create it.”⁹ With the increased salience of innovation and complexity, proactive management under deep uncertainty becomes an everyday requirement. The invisible hand of the market no longer suffices. The framework we offer to assist managers in reconceptualizing their task, given the absence of market mechanisms for hedging such uncertainty, is dynamic capabilities.

In this section, we discuss new sources of uncertainty and useful tools available to managers. We note that the degree of uncertainty has increased dramatically as the global economy has become more advanced and more integrated, allowing the transmission of shocks and the opening of opportunities to

businesses anywhere and everywhere. The “rules” of engagement are becoming increasingly ambiguous as the participants in the (global) economy become ever more heterogeneous, such as the emergence of powerful Chinese multinationals subject to unfamiliar (and occasionally nebulous) forms of governance and regulation. Augmenting the uncertainty are unknown forms of cyber theft coupled with uncertainty due to imperfect information about innovation and the shifting competitive landscape.

A useful analogy for comparing the level of uncertainty in the industrial economy to that in the new (innovation) economy is chess versus mixed martial arts. In chess, almost every move is knowable. The better player almost always wins. There are a large but finite number of moves and counter moves. If the player (e.g., a computer) has unlimited computational powers (i.e., isn’t constrained by normal human bounded rationality), chess is a trivial game, as von Neumann and Morgenstern observed.¹⁰ They noted that “if the theory of chess (i.e., the complex tree of possible games) were really fully known there would be nothing left to play” (p. 125). This is not so in the innovation economy with deep uncertainty. Playing chess has elements of managing risks; managing uncertainty is more like mixed martial arts.

Mixed martial arts (MMA) allows the use of a broader repertoire of techniques. Chess takes place in a “closed world” where the rules are fixed and the nature of the solution is fixed. MMA is more open. For instance, both striking and grappling, both standing and on the ground, are permitted. Boxing, kickboxing, Brazilian jiu-jitsu, judo, and wrestling are widely employed in MMA. Participants cross-train in a variety of styles to counter their opponent’s strength and remain effective in all phases of combat. An MMA fighter has tools such as kicks, knees, and punches that he/she can combine with anything else a boxer or a wrestler must use. Techniques don’t unfold in the contestants’ minds as they might expect. Champions find that expectations and attachments cloud mindfulness and receptivity to what is actually happening. Dominance requires having your mind, body, emotions, and breath competitively connected and calm, waiting without anticipation for whatever happens. Upsets are common in MMA.

The lack of predictability and deep uncertainty for the combatants in MMA is not unlike today’s global innovation economy where existing “rules” are being changed and entirely new “rules invented. To finish the analogy, in the innovation economy new futures emerge with new players (business firms

and banks) owning different assets playing within a broadly circumscribed (by regulation and competition law) set of rules. New entrants are not only combining and recombining technological elements, but also creating entirely new ones. Just how they create and recombine depends in part on strategy. Surprises and “Black Swans” become the norm, particularly when fundamental technological breakthroughs occur and when economic and monetary policy begins traversing uncharted territory, as it has in recent years.

When confronting such circumstances, entrepreneurial managers are needed to redeploy not only financial capital but also technical expertise while balancing stakeholder interests both within and beyond the organization. The entrepreneurial manager is an “orchestrator” giving direction to and coordinating amongst activities. Superior skills as an entrepreneurial manager result from not only more experience and better learning opportunities, but also superior managerial and social capital.¹¹ They are a product, as well, of superior *managerial cognitive capabilities* in relation to the sensing, seizing, and reconfiguring activities central to the microfoundations of dynamic capabilities.¹² Effective entrepreneurial management is especially critical when there is a greater need to achieve organizational agility.

One element contributing to the effectiveness of managers in turbulent environments, and their ability to manage a favorable agility/efficiency tradeoff, is a superior understanding of how to differentiate between the management of risk and uncertainty. The role of organizational agility in modern management cannot be assessed separately from a consideration of risk, uncertainty, budgets, costs, commitment, and strategy. Managers need a general (integrative) framework to grapple effectively with complex, interdependent issues. With the dynamic capabilities framework, we offer general guidance and some managerial principles with respect to how entrepreneurial managers can improve their effectiveness at managing the agility/efficiency tradeoff while guiding the enterprise under conditions of risk and uncertainty.

4. Organizational Agility

The term organizational *agility* is almost a synonym for “flexibility.” In the 1930s, Nobel Laureate economist George Stigler defined flexibility in terms of the firm’s ability to manage demand uncertainties.¹³ Organization theorists have used the term *agility* with a similar but not identical

meaning.¹⁴ Doz and Kosonen define *strategic agility* as the capacity to continuously adjust and adapt strategic direction in a core business to create value for a company.¹⁵ Weber and Tarba define it (somewhat tautologically) as “the ability to remain flexible in the face of new developments....”¹⁶ Worley, William, and Lawler define agility “as the capability to make timely, effective, sustained organizational change... [it is] a repeatable organizational resource.”¹⁷ In a similar way, we refer to *agility* as the capacity of an organization to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant. In addition to managing Stigler’s demand shocks, agile organizations must manage supply-side uncertainty and adjust strategy as necessary and desirable. Organizational agility as a stand-alone concept is limited in terms of the managerial guidance it provides. The role of managers is implicit. Putting routines and self-organization to one side, the economic system needs to decide how to respond to demand fluctuations and other surprises.

Moreover, agility is not a one-size-fits-all solution. Agility is costly to develop and maintain and sometimes even more costly if it is nonexistent. Costs vary according to the structures and systems in place. Issues arise as to how it is best achieved. In one case, it might make sense to maintain redundancy or slack; in another, the best approach may be to build or buy general-purpose equipment or diversify the firm’s customer base. Firms can sometimes buffer themselves against risk by using financial instruments, thereby potentially obviating the need to enable agility through the firm’s asset base. Importantly, the capabilities required to respond to negative events are often different from those needed to take advantage of positive developments. Agility requirements are thus context sensitive. In stable markets, for example, it may be profitable to optimize basic operations and achieve efficiency at the expense of agility because the cost of protecting against possible future disruption may be too lame to justify sacrificing current profits.

However, when there is deep uncertainty, agility is likely to be a valuable organizational attribute—in the hands of good managers. Understanding agility requires an overall framework. We offer the dynamic capabilities framework for this purpose. Considering agility within this framework will help

managers make higher-quality decisions and will help scholars better understand the issues facing management in the innovation economy.

5. Dynamic Capabilities

A firm's dynamic capabilities govern how it integrates, builds, and reconfigures internal and external competences to address changing business environments.¹⁸ This class of capabilities is underpinned by organizational and managerial competences for "reading" the environment and developing business models that address new threats and opportunities. Dynamic capabilities thus defines the firm's capacity to innovate, adapt to change, and create change that is favorable to customers and unfavorable to competitors.

Dynamic capabilities can be thought of as falling into three primary clusters: (1) identification, development, co-development, and assessment of technological opportunities (and threats) in relationship to customer needs (the "sensing" of unknown futures); (2) mobilization of resources to address needs and opportunities and capture value from doing so ("seizing"); and (3) continued renewal ("transforming" or "shifting"). Engagement is continuous or semi-continuous (but not necessarily sequential). Sensing, seizing, and transforming are essential if the firm is to sustain itself in the longer term as customers, competitors, and technologies change.¹⁹

Dynamic capabilities can be analytically separated from the formulation of strategy but must be congruent with the strategic direction that emerges from the strategy process. A strategy that is consistent, coherent, and accommodating of innovation is just as vital as dynamic capabilities to achieving competitive advantage. Hence, while strategy and capabilities can be analytically separated, as a practical matter they need to be developed and implemented together.

While routines and processes are vital components of dynamic capabilities, in our framework strong capabilities are never based entirely on routines or rules. One reason is that routines tend to be relatively slow to change. Good managers think creatively, act entrepreneurially and, if necessary override routines. Put simply, managers matter in our framework.

The role of managerial cognition and human capital in the dynamic capabilities framework was first studied by Adner and Helfat.²⁰ At certain critical junctures, the ability of a CEO and the top management team to sense a key development or trend, and then delineate a response and guide/lead the firm in its path forward, is critical to the firm's dynamic capabilities. But the organization's values, culture, and collective ability to quickly implement a new business model or other changes are also integral to the strength or weakness of the firm's dynamic capabilities. As Bartlett and Ghoshal put it: "As major global competitors achieve parity in the scale of their operations and their international market positions, the ability to link and leverage knowledge is increasingly the factor that differentiates the winners from the losers and survivors."²¹ Knowledge and capabilities are not only scarce but also often difficult to imitate. Sometimes they can be bought; generally, they have to be built. Their astute orchestration requires entrepreneurial capabilities that many management teams don't have.

Managerial decisions determine how the enterprise creates, shapes, and deploys capabilities.²² When this is done well, the effort results in innovative combinations of resources supported by profitable value-capture mechanisms. Technological and business futures are shaped by the ability to imaginatively combine science, technology, and business. Silicon Valley entrepreneur Peter Thiel has remarked on the difficulty of forming radical new combinations. With reference to Elon Musk's Tesla and SpaceX ventures, he notes that "what was really impressive was integrating all these pieces together" and that this is "actually done surprisingly little today and so I think this is a sort of business form that when people can pull it off, is very valuable."²³ This "asset orchestration" and associated integration is an essential element of entrepreneurial management—and of dynamic capabilities.

We believe it useful to distinguish between dynamic and "ordinary" capabilities. Ordinary capabilities enable the production and sale of a defined (and hence static) set of products and services.²⁴ Organizations need access to such capabilities, but they often do not need to practice them or own them, as they can often be outsourced. Ordinary capabilities stem from the proficient employment of the firm's (1) human resources, (2) plant and (tangible and intangible) assets, (3) processes, and (4) administrative

systems, including the coordination needed to combine in-house and external resources. The strength of a firm's ordinary capabilities is a measure of its technical fitness.

Ordinary capabilities allow an enterprise to finish defined tasks with some degree of proficiency. They won't necessarily allow the organization to grow, except perhaps geographically. And they are by definition unable to help the organization respond creatively to positive or negative volatility and/or surprises. The most proficient manufacturers of vacuum tubes with strong ordinary capabilities were defeated by the invention and mass production of transistors. Likewise, few of the best builders of sailing ships segued to the design and production of steamships, and steam locomotive manufacturers like the Baldwin Locomotive Works of Philadelphia completely missed the diesel-electric locomotive revolution.

Knowledge about ordinary capabilities is largely explicit; it may eventually become humdrum. The level of ordinary capabilities can be measured for a particular task or standard. Benchmarking best practice, in a sense, does precisely that.²⁵ Such knowledge can be acquired from consultants and other sources. However, even though ordinary capabilities are ubiquitously available for those actively seeking them and are relatively easy to transfer, they should not be denigrated, as many firms, organizations, and agencies cannot perform even that which is "ordinary" very well. They may simply not be motivated or incited to do so, or there may be other structural impediments in the way. Still, being good at the ordinary is, by itself, not a path to continued prosperity, as enough competitors will likely possess such capabilities so that competition amongst them will sooner or later drive economic profits to zero if those are the only capabilities possessed.

The operations and administrative function of a business is the main place good ordinary capabilities are manifested. Operations involves the delivery of products and services, the associated planning and administration, and the management of supply and demand vicissitudes. The goal of good operation is efficiency and the elimination of waste—what economists call operating on the production possibility frontier, not inside it. In the absence of significant changes in the business environment, operational and administrative problems are usually "solvable," and solutions can often be guided by some optimization program that automatically identifies the resources and processes that minimize the

cost and risk of producing a given set of products and/or services. Nobel Laureate Herbert Kroemer reminds us that “transistors, lasers, and fiber optics did not come out of Six Sigma or ISO 9000 certification quality control programs²⁶”

However, competitive business environments often require frequent reoptimization and never allow firms to run on autopilot for long. Henry Ford perfected the manufacturing efficiency of the Model T but eventually lost competitive advantage when it became obsolete. Many decades later, Nokia likewise got very good at making feature phones, but was overtaken by the smartphone revolution pioneered by Apple. PepsiCo under Indra Nooyi also illustrates the conundrum quite well. When asked about her proudest accomplishments, she replied:

I had a choice. I could have gone pedal to the metal, stripped out costs, delivered strong profit for a few years, and then said adios. But that wouldn't have yielded long term success. So I articulated a strategy to the board focusing on the portfolio we needed to build, the muscles we needed to strengthen, the capabilities to develop...we started to implement that strategy, and we have achieved great shareholder value while strengthening the company for the long term.²⁷

Nooyi chose to bank on strengthening Pepsi's dynamic capabilities, eschewing ordinary ones. Jeff Bezos at Amazon has demonstrated that he also understood the difference between ordinary and dynamic capabilities when he noted that “there are decisions that can be made by analysis...unfortunately, there's a whole other set of decisions that you can't ultimately boil down to a math problem.”²⁸ Undoubtedly, Bezos had in mind figuring out the next big thing, whether it was the Kindle or Amazon Web Services. Dynamic capabilities require a longer-term focus and involve subordinating short-run cost cutting, optimization, and other “best practices” to strengthen dynamic capabilities.

6. Agility through Dynamic Capabilities: Applying the Framework

The dynamic capabilities framework recognizes that risk and uncertainty are qualitatively different. Agility is needed to manage the latter, but not necessarily the former. Moreover, the underpinnings of agility lie mainly in two interdependent elements of the dynamically capable firm: entrepreneurial management capable of combining and recombining technologies, and flexible structures that can be rapidly modified. The firm without entrepreneurs isn't going to be dynamically capable; the

entrepreneur without the “platform” of a well-structured firm isn’t going to be able to accomplish much.²⁹

The entrepreneur needs to help sense the future and act upon it. There is no market for (strategic) information that one can access to buy comprehensive knowledge about the future. Accordingly, the future needs to be “discovered” and possibly created. Critical insights need to be developed and acted upon ahead of rivals. Organizational and managerial capabilities to sense and seize emerging futures need to be nurtured and rewarded. The dynamically capable enterprise is then in a position to itself generate the disruptive forces that upend the business models and market position of competing firms.

However, there are impediments to building an agile, innovative enterprise. An organization may lack sufficient knowledge about itself to know where and when change is needed. Christensen and Overdorf (2000) and Winter (2003) have pointed out that important capabilities are often embedded in the less-visible and background processes that support decisions relating to areas such as investment and resource reallocation.³⁰ This submerged iceberg of internal processes can bar the route to change. In the following sections, we discuss positive steps firms can take to prepare for the unexpected (the unknown unknowns) and help meet customer needs, which capture value for shareholders and other stakeholders.

6a. Effectuating Agility through “Sensing”³¹

In environments characterized by deep uncertainty, companies must sense and/or generate options for growth *before* the market logics of those options become apparent to all. The set of capabilities to achieve this outcome includes *generative sensing, sense making, use of scenario planning, and the “purchase” of real options.*

Generative-sensing capabilities involve undertaking actions to proactively create hypotheses about the future implications of observed events and trends, and testing these hypotheses to grease the pathways for new products, services, and business models. Relatedly, the new product development process requires listening carefully to uses and following customer problems to their deepest foundations, bringing together multiple disciplines and perspectives in the process. Listening is not just an acoustical challenge. It requires time and networking to discover the real root of a problem. Just as inventors see the world differently, so must managers. The capability to sense opportunities before they fully materialize

and ahead of rivals is a crucial component of dynamic capabilities.³² In short, generative sensing is about hypothesis building and learning. It is assisted by “abduction.”³³

Abduction can be seen as a mode of inference where persuasive explanations are developed for surprising (or anomalous) phenomena.³⁴ In contrast to inductive reasoning or sensemaking,³⁵ abductive reasoning uses all available data to generate coherent patterns.³⁶ Charles Peirce (1932), an American philosopher, argued that neither inductive (from specific examples to general principles) nor deductive logic (from general precepts to specific truths) could generate anything truly new, because both depend on the past. Instead, he offered abductive reasoning, which moves ahead through “logical leaps of the mind.”³⁷

Companies can gain the wherewithal for an action to be tested experimentally when they use abductive reasoning.³⁸ Moreover, since an abduction is not necessarily logically or scientifically true, firms must undertake actions to generate outcomes and data to gain confidence in the hypothesis. In establishing the conditions that make the hypothesis true, or stated in the language of logic as affirming the consequent, firms can spot an opportunity not previously recognized. This in turn can spur innovation and cause resources to be allocated to higher-yielding investments.

Put differently, the efficacy of decision rules based simply upon deductive and inductive logic, while important, will be limited. For firms to grow in dynamic and changing environments, their executives must develop generative sensing capability for growth while suppressing a tendency to apply known rules. This perspective is in line with Albert Einstein’s famous remark that:

the intellect has little to do on the road to discovery. There comes a leap in consciousness, call it intuition or what you will, and the solution comes to you, and you don’t know how or why.³⁹

Scenario planning can complement generative sensing. It can be an important internal tool for managing uncertainty and facilitating rapid response to new exigencies. Schoemaker defines scenario planning as “a disciplined methodology for imagining possible futures in which organizational decisions may be played out.”⁴⁰ The basic notion behind scenario planning is that the future presents many possible

outcomes—some contemplated, others never imagined. Good scenario planning enables numerous future scenarios to be distilled down into a manageable number of more-likely scenarios and responses to be thought through. Scenarios aim not to get the future right, but rather to beneficially shape the focus of decision makers and draw attention to areas that would have been otherwise overlooked.⁴¹

Shell pioneered scenario planning, in business settings, several decades ago. This methodology assisted the company during the second oil crisis (1978/1979). Shell’s ability to respond quickly to the crisis encouraged numerous organizations to begin to integrate scenarios into their planning.⁴² Firms such as Nissan and Pacific Gas & Electric Company practice scenario generation as a way to keep management alert.⁴³ The use of scenario planning declined somewhat due to recessions and corporate staffing reductions in the 1980s, but it is still a useful tool.

Related to scenario planning is real options analysis. A real option is “the right—but not the obligation—to undertake certain business initiatives, such as deferring, abandoning, expanding, staging, or contracting a capital investment project.”⁴⁴ Options theorists suggest that if the expected value of transformation was known with certainty and not expected to change, there would be no need to consider various options such as “delay” and “abandon,” because there would be no value to those options.⁴⁵

Firms with strong dynamic capabilities are likely to “purchase” real options (e.g., through research and development investments) and then “exercise” them at the right time for a lower cost than would otherwise be possible. Possessing (“redundant”) capabilities provides organizations with flexibility and options that they can use to customize and configure their resources on an “as-needed” basis. Keeping such options open is not costless.

6.b. Effectuating Agility through Seizing

“Seizing” is about implementation and getting things done. There are ways to do this that preserve agility, including (a) flexible sourcing arrangements, (b) building “slack” into the organization itself, (c) reengineering rule-bound hierarchies, and (d) adopting open innovation processes. We explore the role of each of these organizational approaches in more detail below.

First, consider flexible sourcing. In the industrial age of relatively stable business environments and seemingly inexhaustible economies of scale, vertical integration facilitated optimization up and down the value chain. The Ford Motor Company's River Rouge facility circa 1920 epitomized these arrangements. With its own docks in the dredged Rouge River, 100 miles (160 kilometers) of interior railroad track, its own electricity plant, and ore processing, the titanic Rouge facility was able to produce most components for a complete automobile, including engines, frames, tires, and glass.⁴⁶ It was highly efficient and highly inflexible at the same time.

Implementation of the moving assembly line and other techniques of mass production supported by vertical integration—as significant as they may have been in enabling Henry Ford to manufacture and sell the Model T for an incredibly low price and to manage operational risk—resulted in a capital-intensive facility and associated organizational inflexibility. When sales of the Model T began to decline, Ford was saddled with excess inventory and considerable plant and equipment that it couldn't readily redeploy. In principle, Henry Ford's strategy need not have led to inflexibility, as Ford always had the ability to abandon its fixed (irreversible) investments in specialized tools. But as a practical matter, prior investments locked Ford into manufacturing the Model T for too long. The cognitive foundations of this trap have been explored elsewhere.⁴⁷ It took shutting down the plant and massive product and process redesign to enable the Ford Motor Company to follow along with the Model A.

One way to untether management decisions from the effects of large fixed investments is to preserve maximum flexibility by both outsourcing one's manufacturing and preserving contractual flexibility. This is what Apple appears to have done with its outsourcing of the manufacturing of the iPhone to Foxconn, a Taiwanese company with a large manufacturing base in mainland China. Such an arrangement allows Apple flexibility with respect to manufacturing, although contractual terms still in part govern the amount of flexibility available. The notion here is that it is generally (but not always) easier to "walk away" from an outsourced facility (by definition, owned by a third party) than from one's own 100 percent-owned facility.

Flexibility comes from the totality of the situation. For instance, in the Foxconn case, Steve Jobs decided (at the eleventh hour) before the launch of the iPhone to switch the face of the iPhone from plastic to glass, as he had discovered that the plastic face was too easily scratched. An executive's account of how this last-minute change was handled by Foxconn involves a foreman who immediately roused 8,000 workers inside the company's dormitories. Each employee was given a biscuit and a cup of tea, guided to a workstation, and within 30 minutes started a 12-hour shift fitting glass screens into beveled frames. Within 96 hours, the plant was producing over 10,000 iPhones a day. "The speed and flexibility is breathtaking," the executive said. "There's no American plant that can match that."⁴⁸

Clearly, the terms of the suppliers' underlying contracts with workers, and the employees' degree of commitment to their employer, along with the nature of supplier relationships with Apple (and vice versa), modulates the flexibility of Apple's supply chain. Put differently, there is no longer a simple answer as to whether in-house or contract manufacturing offers greater flexibility. Vertical integration may have once offered greater flexibility, because of implied "spot" or variable contracting relationships with in-house suppliers, but this generalization is no longer true.

Flexibility can sometimes be "designed in" to the supply chain, albeit at great expense. An electric utility can design its boilers to be fired by coal, gas, or oil; it can switch fuels depending on the relative price of each fuel. Indeed, engineering designs are replete with examples when flexibility can be "designed in" at a cost. Amphibious vehicles can go on land and sea, but they cannot do either as well as a vehicle designed specifically for one or the other.

Another set of approaches involves building agility artfully and purposefully into the architecture of the organization itself. Chief among these approaches are the maintenance of organizational slack and employment of one of several possible organizational structures. We discuss these in turn below.

It has long been recognized that although costly, "slack" (maintaining excess resources and capacity) assists agility, much like holding cash helps insulate an investor from external vicissitudes. Maintaining organizational slack can complement cash holdings as a buffer against operational outages/failures. Thus major air carriers keep spare planes in case existing aircrafts are pulled out of

service; electric utilities pay for “spinning” capacity so they can meet demand spikes; schools have substitute teachers available on call; and the permanent military, itself often not engaged in combat, nevertheless maintains reserve forces.

The establishment of significant inventories to buffer the manufacturing process is another example of programmed “slack.” However, the maintenance of such buffers can be expensive. Toyota’s invention of the *just-in-time* (JIT) system was an effort to eliminate the high cost of slack. JIT was designed to not just save inventory costs (i.e., reduce the costs of slack) but also force higher levels of care and quality throughout the supply chain and in automobile assembly itself. In the context of innovation, which is center stage for dynamic capabilities, slack is an insufficiently granular concept. For instance, parallel drug developments in the pharmaceutical context drives home that “slack” need not be excess in a fundamental sense.⁴⁹

Organizational structure also has strong implications for agility. Rule-bound hierarchies with many vertical levels can be traced back at least to Egyptian times. Specialization cascades down through the hierarchy, thereby minimizing skill requirements for individuals at the bottom. Knowledge is shared on a need-to-know basis. Despite its long lineage, hierarchy can be the enemy of agility. While hierarchical structure can actually be highly efficient in performing a defined task at high volume/scale, there are serious ramifications from concomitant rule rigidity. A problem with deep hierarchy is that information from the bottom does not readily flow to the top, and it arrives distorted if it arrives at all. This is especially problematic when the business environment is undergoing rapid changes. Moreover, hierarchical organizations usually become highly bureaucratic. Being rule-bound allows little if any flexibility/agility. Change in bureaucratic organizations requires the “chief executive” and significant senior management “rewrite the rule book,” which can be incredibly time consuming. As such, the hierarchical and bureaucratic forms of organization, private or public, are ill adapted to environments of rapid change.

In nature, a strong element of self-organization (implying an absence of hierarchy) often works to support agility. The behaviors of a hive of bees, a flock of sheep, a gaggle of geese, or a herd of antelope

sometimes speak to this. In human society, self-organizing systems would have no hierarchy and no singular leader. Rather, the “organization” would consist of a network of individuals who self-identify as members. Pure forms do not exist. However, quasi self-organizing organizational modalities in business can exist and often provide greater agility, because decisions can be made in a decentralized manner, and this generally results in greater responsiveness.

Multidivisional organizational structures can assist responsiveness and “seizing.” They allow significant levels of decentralization. One way to decentralize is through product charters/mandates. With this approach, management “assigns” new product development to particular divisions and rolls out mandates, taking into account divisional capabilities and the presence (or absence) of resources. By controlling the assignment of such charters/mandates from headquarters, management can orchestrate the company’s resources to meet changing market needs, thereby enhancing agility.

Open innovation methodologies can also assist agility by enriching and speeding up new product development to meet nascent market opportunities. Chesbrough defines open innovation as “the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation respectively.”⁵⁰ There is little doubt that open innovation can be used to augment internal efforts to drive innovation, quickly and flexibly. Firms can utilize outside-in or inside-out processes (e.g., forming an external spinoff to further develop technology outside the originating firms, or out-licensing rejected projects to external parties to utilize the ideas).⁵¹ Open innovation is especially powerful when the sources of invention/creativity are widely dispersed, organizationally and geographically.

6.c. Achieving Agility through Transforming/Pivoting

In recent years, a popular methodology has emerged that is promising, if not proven, for building agility into the new product development process, particularly in the new enterprise context. The methodology has sometimes been put forward as “build-measure-learn.” The idea is that when managing under uncertainty, (when possible) build a minimum viable product (MVP), launch it, learn quickly, adjust accordingly, and improve. As Eric Ries puts it:

Once entrepreneurs embrace validated learning, the development process can shrink substantially. When you focus on figuring the right thing to build... the thing customers want and will pay for, you need not spend months waiting for a product beta launch to change the company's direction. Instead, entrepreneurs can adapt their plans incrementally.⁵²

The "lean startup" methodology, as it has come to be known, favors experimentation and prefers learning to elaborate planning. Failing fast and regrouping are the order of the day. The methodology accepts that business plans are of limited utility when there is high uncertainty. It embraces "agile development." It supposedly "eliminates wasted time and resources by developing the product iteratively and incrementally."⁵³ According to Steve Blank, incumbent firms can also transform using the lean startup approach.

Lean startup has been widely touted and taught. It is most applicable where product development costs are relatively low and adjustments (revisions) lower still. It fits comfortably for software development, less so for aircraft or even automobiles. Implicitly, it deals with circumstances where irreversibilities do not pose costly challenges to transformation, and where rapid feedback and learning from customers is possible. It is not surprising, therefore, that the methodology is fashionable and helpful in the era of the Internet. However, it helps make our larger point that the costs and benefits of particular approaches need to be assessed. Context matters, and the applicability of general rules is limited.

In large established organizations, transformation is more difficult but not impossible. It requires breaking conventional modes of thinking. It often takes a crisis to effectuate significant change; the role of good leadership is to articulate the need and direction of change and achieve momentum in doing so, irrespective of whether a crisis exists. Sometimes, however, change may not be possible because of entrenched interests, human stubbornness, or deep misunderstandings about the need and desirability for change. Change is much easier if a culture exists that embraces change.

The above approaches do not encompass the full set of levers that can be employed by managers to enhance organizational agility in a cost-effective manner. They are meant only to suggest the range of options open to entrepreneurial managers/leaders hoping to enhance their firm's dynamic capabilities. Other methods that enhance agility include implementing truces and understandings both inside the

enterprise and with outside partners. Such arrangements allow for more timely accommodations and adjustments.⁵⁴ Of course, leadership and learning is required for all of the above to be effective.

By drawing on a variety of approaches and mechanisms as illustrated, managers can enhance their entrepreneurial skills and develop a practical approach toward navigating the efficiency/agility tradeoff. Their ability to do so in an organizational setting will be enabled by the dynamic capabilities of the enterprise and modulated by the cost of attaining a given level of organizational agility.

7. Distilling a Contingent Approach to Agility Using the Dynamic Capabilities Framework⁵⁵:

Derived Principles

The dynamic capabilities framework indicates a set of principles that entrepreneurial managers should and usually do understand. In particular, managers must recognize that the pursuit of agility requires sensing, seizing, and transforming and often puts ordinary and dynamic capabilities in conflict. Observers note that “the cruel joke is that in attempting to preserve their source of advantage, organizations can overcommit to institutionalization, making them more inert and vulnerable to environmental shifts.”⁵⁶ It is of great importance to understand when companies (inadvertently or deliberately) overcommit to wooden structures, and where maintaining and enhancing agility ought to be a managerial priority.

Achieving organizational agility often involves sacrificing technical efficiencies. If not for this tradeoff, organizational agility would not be so hard to achieve, and ordinary and dynamic capabilities would always be additive. Because of these costs and tradeoffs, it is generally best to shield the organization through insurance/hedging when the challenge is merely to manage risk. This is because insurance/hedging and the installation of risk management procedures and protocols are less disruptive of operations, and can reduce the amount of adjustments and adaptation the organization needs to make to remain competitive.

While the tradeoff between agility and efficiency is sometimes recognized in the field of economics, it has received less attention in the field of strategic management and is almost never mentioned in organizational theory.⁵⁷ Only very limited attempts have been made to offer prescriptive

advice to managers regarding how to negotiate this tradeoff. Even when observers define agility as “a higher-order dynamic capability that is built over time,”⁵⁸ they do not usually consider tradeoffs. We have endeavored to redress this deficiency. We propose that more effective management under risk and uncertainty requires entrepreneurial managers to comprehend and apply the following basic principles that are derived from and/or are consistent with the dynamic capabilities framework:

i. Uncertainty in the business environment manifests itself in unpredictable turbulence, disruption, and hypercompetition. Innovation and interdependence are key drivers. They sometimes lead to shocks and an associated period of disruption, followed by relative calm.⁵⁹ Even in environments where the turbulence is relatively continuous, the level of environmental dynamism may range from periods of smaller changes to those of more seismic shifts. Such uncertainty, which often results from technological and business innovation and political events, is more difficult to manage than risk.

ii. Risk can and should be managed differently from uncertainty. The tools for managing the former do not work for the latter. With access to well-developed financial markets, insurance and hedging contracts and the installation of risk management procedures may suffice to buffer the organization and protect the business and the business model from risk. However, such mechanism provides little protection or advantage under uncertainty. To the extent that success with risk management lends managers to believe that the enterprise has guarded against uncertainty, the rigorous pursuit of risk management protocols and procedure can be dangerous.

iii. The first task in managing those business enterprises competing in environments exposed to perturbation and disruption is to determine whether the source of change is primarily risk or primarily uncertainty. If it is the former, one may not need to engage in the expense and incur the tradeoffs associated with building a highly agile or flexible organization. Dynamic capabilities are less essential; strong ordinary capabilities may suffice. Contractual arrangements with external providers and partners are an integral aspect of obtaining the flexibility needed to handle risk, which relates to relatively foreseeable events.⁶⁰ “Predictable” risk can be managed through equipment design,

financial contracts, natural hedges, and the rigorous implementation of risk management procedures and protocols.

iv. More flexible plants and equipment can enable the firm to deal with frequent changes in the rate of production. For instance, more complex refineries (which require greater capital investment and hence higher capital costs) can accept a more varied diet of crude oils, from heavy to light, and from high sulfur to low sulfur. Perhaps these forms of flexibility should be called “engineering,” physical flexibility, or “level-one” or “baseline” agility. While flexible design options may be available, they often compromise performance in one or more areas, add to cost, or both. This explains why not every car is amphibious, not every military aircraft is both a fighter and a bomber, and not every residential home is built with an extra bedroom. Thus, flexibility is not the main management challenge we have in mind as we consider agility.

v. Not all business environments face strong dynamic competition generating deep uncertainty at all times. Industries and markets may evolve calmly for a while, inside a relatively stable paradigm that is then disrupted as a new dominant design emerges. This phenomenon has been characterized as an innovation cycle,⁶¹ the workings of a technological paradigm,⁶² or conditions of “punctuated equilibrium.”⁶³ In these circumstances, periods of disequilibrium are separated by epochs of relative calm. Former Intel CEO Andrew Grove chose to reference the end of one epoch and the beginning of another as “inflexion points.” Uncertainty may give way to risk in interim periods.

vi. This relative calm allows for forms of “business as usual,” even though the organization must remain vigilant and be ready for rapid change when needed. Since change is costly, it may not make sense to manage as if there is constant turbulence when turbulence is in fact only periodic. Knowing when inflexion points will occur requires good “sensing.” Some organizations are better at recognizing inflexion points. For instance, when Netscape went public, signaling the new internet era

had arrived, companies including Microsoft worked frantically to formulate and develop internet strategies.

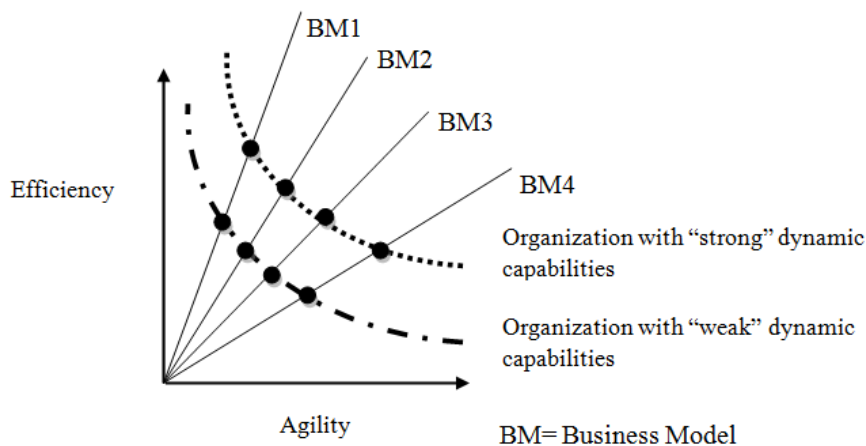
vii. The net benefits (i.e., benefits minus costs) of organizational agility increase with the degree of uncertainty in the organization's competitive environment.⁶⁴ Managing in highly uncertain environments is like managing at the edge of chaos⁶⁵, requiring high levels of organizational agility and perhaps specialized types of decision making and dynamic capabilities.⁶⁶ Kahnman's system one thinking can help one react quickly to the environment, and slower and more analytical system two thinking to correct mistakes from system one thinking⁶⁷. At the other extreme, if the environment is quite stable, with little or no dynamism, then the costs of maintaining organizational agility are likely to outweigh the benefits.

viii. To better manage deep uncertainty, business firms need to quickly generate a (novel) hypothesis about what is going on in the business environment. Abductive reasoning can assist this process. Imagination and strong intuition, triggered by early detection of new developments, are needed. Scenario planning can also help. Cost of hypothesis generation and sensemaking cannot be ignored⁶⁸. Decisions need to be theory informed, evidence based (where possible) and insight driven⁶⁹. These approaches will allow cognitive engagement with the business environment⁷⁰.

ix. Strong dynamic capabilities can yield organizational agility while minimizing the cost of achieving a particular level of organizational agility, thereby allowing management to achieve a more favorable tradeoff between agility and efficiency. The dynamic capabilities framework suggests that while the tradeoff between efficiency and agility may never be eliminated, organizations with superior (strong) dynamic capabilities can experience lower costs associated with maintaining a given level of organizational agility. They may be less confined to a particular efficiency/agility tradeoff, as Figure 1 illustrates. We show broken tradeoff curves because we do not want to imply that an infinite

number of organizational/business model choices are available to most firms. These are not. The four rays illustrate the availability of a non-infinite number of business models (BM1 through BM 4). We depict four business models for each of the two levels of dynamic capabilities depicted. The black dots are available options. The curve lines merely suggest relationships. Not every point on the curve is an option available to management.

Figure 1: Uncertainty and the Tradeoff between Efficiency and Agility in Organizations with Strong/Weak Dynamic Capabilities



x. Transformation is hard for established enterprises but relatively easy for startups. When transformation/pivoting is easy, the dominant modality should be to move forward (start seizing) while learning, and as new understandings emerge, to “pivot.” This is much harder to do with established enterprises, as it requires unshackling bureaucratic (and power) relationships. As venture capitalist John Doer points out, “It’s easier now than ever to start a new venture and harder than ever to build a durable company.”⁷¹

The above principles are derived from (or are at least consistent with) dynamic capabilities thinking. We believe that implementation of these principles can best be done under the sensing, seizing, and transforming rubrics. Analysis under each cluster of microfoundations can benefit from consideration

of these (derived) principles. Put differently, sensing, seizing, and transforming are three clusters of dynamic capabilities that must be built to achieve evolutionary fitness. When coupled with strategy, each helps achieve judicious levels of agility.

8. Agility and Strategy

No matter how astutely entrepreneurial management copes with risk and uncertainty, how effectively it diagnoses what's happening in the marketplace, or how well it manages the flexibility/efficiency tradeoff, all is for naught if these activities are not aligned with a good strategy. Strong dynamic capabilities allow a company to “roll with the punches” and tap into new opportunities. But as we have emphasized, underlying agility has opportunity costs and should only be built for worthwhile purposes. These issues implicate strategy.

The effectiveness of even strong dynamic capabilities can be compromised by poor strategy and poor strategic leadership. As noted elsewhere, the greater the uncertainty and dynamism in the business environment and the greater the need for organizational agility, the more critical good strategy, entrepreneurial management, and strong dynamic capabilities become for the firm's growth and financial performance.⁷²

Analogies outside of business make this apparent. In boxing, the prizefighter must stay agile and “keep up on his toes,” ready to dodge the next blow from an adversary, or better still, to strategically place one. Agility and strategy work in tandem. In some cases, agility will be sacrificed to aid strategy, as in the case of commitments to production capacity.

The fact that reducing agility is sometimes desirable speaks to the importance of building strategy into agility frameworks, which the dynamic capabilities framework requires. Agility does not always create or preserve value. For example, a decision implies (or signals) commitment when significant irreversibilities occur (i.e., there is no low-cost way of going back). The Spanish conquistador Herman Cortez's famous “burning of the ships” in 1519 upon his arrival in Mexico (a reduction in agility by closing off retreat) is an example where agility was sacrificed to try to engender going-forward

commitment.⁷³ Likewise, in Homer's *Odyssey*, Odysseus tied himself to the mast (a reduction in agility) to avoid the temptation of the Sirens. Clearly, strategic choices and organizational designs need to be managed together, and more agility, even putting cost to one side, is not always better.

In the context of warfare, agility is a valuable force characteristic. Hence the justification for the significant investments made in the United States in Special Forces and rapid deployment forces.⁷⁴ Such forces typically consist of elite military units (special operations, Marines, etc.) that are usually better trained and have priority with respect to new equipment. The French Foreign Legion or the British Royal marines (31st infantry) are non-U.S. examples.

An excellent example of the interdependence of agility (a capability) and strategy is the Battle of Trafalgar (off Cape Trafalgar, Spain) in 1805. This was a naval engagement fought by the British Royal Navy against the combined French and Spanish fleets during the Napoleonic Wars. Historians never fail to give credit to the British Admiral Lord Nelson's strategy: engaging the enemy fleet by dividing his smaller force into two columns directed perpendicular to the larger enemy fleet—a complete break from prevailing tactical orthodoxy (which was to engage parallel, in a single line). Less frequently mentioned is that in pursuing this strategy, Admiral Nelson hoped to (a) isolate the enemy's flagship (leading to a lack of coordination) and (b) create chaos on the water. In the ensuing chaos, there would necessarily be ship-to-ship actions, in which Admiral Nelson's more agile ships and crews would have a better chance. Lord Nelson knew that the better seamanship and faster reloading speeds of the Royal Navy gunners would play a key role. The strategy would favor his ships' and his crew's capabilities over their Spanish and French adversaries. In short, Admiral Nelson's strategy leveraged the more agile capability of his naval force. Despite a smaller number of ships, he was able to pull off a decisive victory.

Lord Nelson's victory at Trafalgar was not through strategy alone, which is often assumed, but by marrying capabilities (and in particular agility) and strategy. Put differently, the value (and the need for) agility cannot be calibrated properly absent considerations of strategy. That is the place to which the dynamic capabilities framework leads the analyst (and the managers). As General de Gaulle supposedly once said, "You have to be fast on your feet and adaptive, or else a strategy is useless."⁷⁵ The converse is

also true. When available, flexibility/agility can be costly and will not yield commensurate benefits unless married to a good strategy.

9. Conclusion

Organizational agility is a much-touted attribute and usually considered virtuous. However, there are associated costs, and the existing literature does not explain when agility is desirable, the nature of its foundations, and how, if at all, it relates to strategy. By viewing agility within the dynamic capabilities framework, we advance the notion that agility should be sought only in harmony with the requirements of the business environment and with the firm's strategy. Fortunately, agility is usually unnecessary in business environments exposed merely to risk. On the other hand, it is essential when confronting the deep uncertainty and associated threats and opportunities characteristic of today's innovation economy.

The type of agility that (entrepreneurial) managers choose to build into their organizations and maintain should depend on their strategy and positioning in the market and the desire to prepare for both downside and upside. That said, if firms have strong dynamic capabilities, they will be better at sensing emerging developments; moreover, they will achieve agility with less sacrifice of efficiency, along with making better use of whatever agility they possess. This is because they will, by definition, be better at sensing, seizing, and transforming.

However, one should not conflate agility and dynamic capabilities. The latter has far more elements and, when practiced well, provides the enterprise greater robustness. While firms with strong dynamic capabilities are likely (if facing deep uncertainty) to be agile, firms may perform well in stable or even predictably volatile (i.e., risky) environments without having made costly investments in agility. The dynamic capabilities framework helps one understand the costs and payoffs to agility, when to build agility in and when not to, and when to sacrifice it.

Dynamic capabilities is the framework that can help guide managers with respect to when and how to manage under deep uncertainty. As we have discussed, the framework helps assemble the elements needed to decide when to invest in agility and when to rely on the standard tools of risk

management. Traditional strategy frameworks are not only silent on such matters but also deflect management from focusing on them. Dynamic capabilities propounds that, in regimes of deep uncertainty such as those which characterize sectors of the economy experiencing rapid change, management must prime the organization for sensing, seizing, and transforming, and marry the right strategy to the firm's capacity to be agile.

When that environment is saturated with deep uncertainty, dynamic capabilities ought to be the CEO's leitmotif, as it delineates pathways that allows escape from the agility/efficiency tradeoff. Abductive reasoning and imaginative hypothesis building need to kick into gear quickly when there is deep uncertainty about the future. Second, when needed, agility can be achieved by multiple organizational modalities. We note that agility needs to be married to strategy to be meaningful. Finally, while not developed directly, we note that agility may sometimes be a fool's errand; enterprise death may in fact be the best solution if squandering resources to transform would leave stakeholders worse off. Because dynamic capabilities requires strategy to be coupled to agility, only when everything is working well together can value be created and captured and durable competitive advantage realized.

The dynamic capabilities framework highlights interrelationships that need to be understood if managers are to build and maintain competitive advantage. It helps set priorities and enable coherence between strategy, structure, and the business environments.

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- ⁵⁶ E. Lawler, T. Williams, and C. Worley, "The Agility Factor" (Jossey-Bass, 2014).
- ⁵⁷ E.g., Stigler (1939), op. cit.
- ⁵⁸ E.g., Doz and Jisibeb (2008), op. cit.
- ⁵⁹ Even among environments where the turbulence is relatively continuous, the level of environmental dynamism may stem from low (characterized by small, incremental change) to high (characterized by greater, more disruptive change). Hence, one may not need to exercise high agility at all times.
- ⁶⁰ B.H. Klein, *Prices, wages and business cycles: A dynamic theory* (New York: Pergamon, 1984).
- ⁶¹ W.J. Abernathy and J.M. Utterback, "A Dynamic Model of Process and Product Innovation," *Omega*, 3 (1975): 639–656.
- ⁶² G. Dosi, "Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change," *Research Policy*, 11 (1982): 147–162.
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- ⁶⁴ The concept of high-velocity markets is similar (Bourgeois and Eisenhardt, 1988). These ideas are also captured in one of the concepts of next-generation competition (Teece, 2012). L.J. Bourgeois and K.M. Eisenhardt, “Strategic decision-process in high-velocity environments – 4 cases in the microcomputer industry,” *Management Science*, 34 (1988): 816–835; D.J. Teece, “Next Generation Competition: New Concepts for Understanding How Innovation Shapes Competition and Policy in the Digital Economy,” *Journal of Law, Economics and Policy*, 9 (2012).
- ⁶⁵ S. Brown and K. Eisenhardt, *Competing on the edge: strategy as structured chaos* (Harvard Business School Press, 1998).
- ⁶⁶ K.M. Eisenhardt and J.A. Martin, “Dynamic capabilities: What are they?” *Strategic Management Journal*, 21 (2000): 1105–1121; M. Peteraf, G. Di Stefano, and G. Verona, “The elephant in the room of dynamic capabilities: Bringing two diverging conversations together,” *Strategic Management Journal*, 34 (2013): 1389–1410.
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- ⁶⁸ See D. Russell, M. Stefik, P. Pirolli, S. K. Card. *The Cost Structure of Sensemaking*. In *Proceedings of InterCHI '93*, p.269-276, 1993. Amsterdam.
- ⁶⁹ This includes insights into customer needs
- ⁷⁰ For analogous treatment of the invention process, see Mark Stefik (Barbara Stefik, *BREAKTHROUGH*, MIT Press, 2004 p.65-66
- ⁷¹ Wall Street Journal, April 1, 2016
- ⁷² Teece (2014), op. cit.
- ⁷³ P. Ghemawat, *Commitment: The Dynamics of Strategy* (New York: Free Press, 1991).
- ⁷⁴ The 82nd Airborne and 75th Ranger regiment are the best examples of rapid deployment forces.
- ⁷⁵ De Gaulle C. BrainyQuote. Available at: <http://www.brainyquote.com/quotes/quotes/c/charlesdeg119209.html>. Accessed March 14, 2016.