

# Evolutionary Economics, Routines, and Dynamic Capabilities

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# Evolutionary economics, routines and dynamic capabilities

David J. Teece\*

## Abstract

Evolutionary economics has been a key influence on strategic management and especially on the dynamic capabilities framework, where it is a foundational pillar. However, the emphasis by evolutionists is on fleshing out a theory of routines while downplaying the bold entrepreneurial moves that drive the business enterprise — and the economic system — forward. The dynamic capabilities framework, by embracing the role of entrepreneurial managers, including the development of a change-oriented organisational culture, the achievement of asset alignment and the placing of bold (but smart) bets, provides the basis for a more realistic model of firms as they compete in fast-changing and uncertain business environments.

Keywords: dynamic capabilities, evolutionary economics

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## Introduction

The perspective of evolutionary economics has had a decided impact on strategic management, primarily through the resource-based view of the firm and the dynamic capabilities framework (Helfat 2018). In this paper, I will consider the relationship between dynamic capabilities and evolutionary economics.

Evolutionary economics intersects most poignantly with the capabilities literature around the concept of routines. Winter (2000, p.983) defines an organisational capability as:

a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type.

The presence of 'outputs' in this definition makes clear that it applies to operational (or 'ordinary') capabilities. Management is at least implicitly involved here: coordinating routines, 'implementing input flows', and choosing the type and level of outputs. It appears to be the routines that define the scope of managerial activity in evolutionary economics.

Another type or level of capability is required to account for how firms add entirely new ordinary capabilities and eliminate old ones. Teece, Pisano and Shuen (1990, 1997) called this the 'dynamic capabilities approach'.

Although Nelson has not written much about dynamic capabilities, he was quick to see their potential, noting in response to the initial 1990 working paper version of Teece, Pisano and Shuen (1997) that:

the 'dynamic capabilities' view of firms being developed by scholars in the strategy field can be seen to be important not only as a guide to management, but also as the basis for a serious theory of the firm in economics. It, when embedded in an evolutionary theory of economic change, instructs us regarding 'Why do firms differ and how does it matter?' (Nelson 1991, p.72)

Winter, by comparison, has written a fair amount about dynamic capabilities, but almost always with a view to constraining them within the bounds of routines. When he first examined dynamic capabilities in depth, he simply applied his earlier definition of all capabilities as routines, i.e. 'behavior that is learned, highly patterned, repetitious' (Winter 2003, p.991).

When revisiting the topic later with Helfat, Winter endorsed a more expansive definition of dynamic capabilities as the capacity of a firm to 'alter how it currently makes its living' (Helfat and Winter 2011, p.1244).

However, from a strategic management perspective (and, ultimately, as a matter of economics), this approach remains too restrictive to the extent that it precludes a role for entrepreneurial decision-making. Winter (2003) was presumably afraid that doing otherwise would require him to embrace 'ad hoc problem solving'. Perhaps that is also the reason Helfat and Winter (2011, p.1248) touch on the 'dynamic capabilities of top managers' only in passing, despite Helfat's pioneering work on the topic (Adner and Helfat 2003). Yet, as I will make clear in what follows, strategic decisions of dynamically capable managers are vital to the fates of firms and the dynamics of industries.

As the contrast between Nelson's and Winter's responses to dynamic capabilities makes clear, evolutionary economics is not uniform in how it views capabilities and the prospects for strategic renewal. There is a fundamental tension in the evolutionary approach over the relative importance of continuity versus novelty, as represented by the separate outputs of its two chief pioneers. Whereas Winter's view emphasises routines and the cost of changing them (e.g.

Winter 2003), Nelson has been more focused on the ability of firms to innovate in technology and organisation, and to create competitive advantage (e.g. Nelson 1991).

Since Nelson's early assessment of dynamic capabilities as a potential element within an evolutionary model, I have been constructing an evolution-consistent framework of the firm built around dynamic capabilities. I believe the dynamic capabilities framework can serve as a vehicle for clarifying the relationship between routines and innovation. Combining them in a framework in which entrepreneurship and strategy also have their place can better account for how firms change — and how they change industries.

The paper proceeds as follows. I start by recapping the separation between routines that evolve and one-off managerial decisions. This is followed by sections arguing that entrepreneurship is hard to capture in an evolutionary framework, provide examples of it in its pure form and describe its role in the dynamic capabilities framework as part of 'entrepreneurial management'. Next, I contrast dynamic capabilities and the evolutionary model of the firm in more detail, particularly with respect to innovation, change and strategy. A brief section concludes.

## Can routines do it all?

In Nelson and Winter's (1982) pathbreaking evolutionary model of the firm, the primary activities are building and exploiting knowledge assets using organisational 'routines'. As noted, organisational learning, in the form of processing information and solving problems, leads to new knowledge and improved routines. As routines evolve, each firm generates a unique trajectory. Some firms are better at learning, and some firms learn the wrong lessons and eventually fail.

Despite several decades of research on routines, much of the literature remains enigmatic (see Becker, Lazaric, Nelson and Winter 2005). Some observers find contradictions, claiming that the same 'recipes' support different ways of performing activities (e.g. Kenney and Florida 1991; Adler 1993). I do not doubt the power and importance of routines at the operating level.

Organisations need routines to get the day-to-day work done. They economise on bounded rationality. The dynamic capabilities framework recognises routines as the very essence of operational (ordinary) capabilities.

In general, though, the concept of routines is simply not rich enough to account for the most important features of the firm. The inherent nature of the routine-based evolutionary approach is that search tends to be 'close in' or local. Routines improve through repetition and through mutation/perturbation plus internal selection. Business can also benchmark their routines/processes, identifying and adopting industry 'best practices'. Rarely, however, do all firms end up using the same routines/practices — or practising them with equal skill (Bloom, Genakos, Sadun and Van Reenen 2012). Considerable dispersion occurs, with only a few 'frontier firms' that develop and/or copy best-practice routines.

In terms of building a model of the economy, the evolutionary approach can therefore point to routine-based capabilities alone as a primary explanation for differences in firm performance. But this excludes multiple major sources of inter-firm heterogeneity. The top management team, or corporate culture and structure for that matter, are very much in the background. Yet any reading of business history of the past 150 years would be incomplete indeed if it did not include the activities of great innovators and integrators such as Henry Ford, Thomas Edison, Charles Merrill, Sam Walton, Walt Disney, Bill Gates, Steve Jobs and Elon Musk, who each transformed one or more industries by pursuing a singular vision with unusual skill. While these individuals had exceptional talents, every company has the potential to strengthen its dynamic

capabilities by diffusing an entrepreneurial state of mind throughout its structure. The entrepreneurial decision-making critical to the exercise of dynamic capabilities lies outside the purview of evolutionary economics.

While the honing of routines is vital for 'doing things right' (i.e. efficiently), routines are just one contributor to 'doing the right things' (i.e. figuring out where and how to invest for the future). It is not evident that routines are helping Elon Musk, CEO of Space-X, decide how to get a crew to Mars and make money as the programme evolves. Nor is it clear that routines helped Steve Jobs create the iPhone ecosystem; or that they played any role in helping Jeff Bezos at Amazon decide to offer commercial cloud computing services.

These decisions about 'doing the right things' lie at the core of business strategy. The quality of these decisions, along with luck, shape the evolution/progress of the firm, and they are anything but routine. Although signature routines may be involved (Gratton and Ghoshal 2002), they still require some amount of entrepreneurial decision-making. This in turn requires an entrepreneurial state of mind: a high level of creativity, a high level of energy, relatively low risk aversion, the ability to see new opportunities and new combinations, a sense of urgency and a bias for action.

Routines (and capabilities), on the other hand, are equated with a recipe or a programme, implying that they could potentially be carried out by simple automatons. Nelson and Winter (1982, p.94) made clear that they 'emphasize the automaticity of skillful behavior and the suppression of choice that this involves.'

Yet these tasks must still be coordinated and managed. Nelson and Sampat (2001) call routines the 'physical technology' and their deployment the 'social technology'. This deployment — or what I call 'seizing' in dynamic capabilities terms — is absent or underdeveloped in evolutionary models of the firm. It is unclear if dynamic capabilities can even be modelled in an evolutionary framework.

There are any number of studies taking an evolutionary approach to capabilities, but the capabilities involved are, for the most part, what I call 'ordinary capabilities' or, in some cases, what Winter calls 'first-order capabilities' (and others call 'metaroutines'), i.e. involved in changing existing capabilities (and routines) in incremental ways (Winter 2003; Adler, Goldoftas and Levine 1999; Hoopes and Madsen 2008).

Most ordinary capabilities can be benchmarked to industry best practices. However, the ability to do so indicates the likelihood that the benchmarked capabilities can be bought or imitated by rivals and hence are unlikely to be a source of competitive advantage. Some ordinary capabilities are specialised and proprietary, and can serve as a competitive wedge for an extended period. Toyota's lean production model, a tightly integrated set of processes, is one example (Womack, Jones and Roos 1990). Important elements of the 'Toyota Production System', such as just-in-time supplies and quality control circles, gradually diffused to rivals, but Toyota's unique implementation provided the carmaker with a source of competitive advantage for decades and, arguably, still does (Fruin and Nishiguchi 1990).

Teecian dynamic capabilities, by comparison, are higher order bundles of organisational routines and managerial decisions that drive the strategic activities of the business enterprise competing in regimes of deep uncertainty (Teece 2012; Teece, Peteraf and Leih 2016). I see dynamic capabilities residing primarily not in first-order change routines, but in the characteristics of the top management team, in the organisational culture and structure, and in the supporting organisational routines that are under the stewardship of top management.

As noted earlier, evolutionary theorists are reluctant to adopt this perspective, perhaps for fear it would require one to embrace what Winter (2003) characterises as 'ad hoc problem-solving'. For

Winter (2003 p.991), 'Brilliant improvisation is not a routine.' However, a series of brilliant improvisations may indicate the existence of a quasi-routine for how an entrepreneurially-led organisation solves problems. Furthermore, what may appear ad hoc to someone else may have a logic of its own not readily understood by others — a notion captured to some degree by Rumelt's concept of uncertain imitability (Lippman and Rumelt 1982).

Part of the problem may be that the key concepts of evolutionary economics and organisational routines developed in a world before the second digital age and the 'big data' revolution. In today's world, the set of production possibilities, monetisation strategies and competitive opportunities arising from large, diverse and numerous datasets is vast, which augments complexity and deepens uncertainty. The payoffs from high-level routines for learning and search are relatively modest, but the payoffs from strong dynamic capabilities for learning and search are substantial. The evidence is not hard to find. Silicon Valley firms have been making large investments in AI systems designed to 'sense, think and act' in complex data environments. This is analogous to the learning ethos of dynamic capabilities, namely sensing, seizing and transforming.

Perhaps there is a definitional problem. Winter (2003) divides activities and decisions in a binary way; they are either routine or ad hoc. But entrepreneurial decision-making is a hybrid, involving creative decisions that are informed by, and that control, repeatable and repeated business processes. Arndt and Pierce (2018) note that dynamic capabilities involve a number of activities that fall into this hybrid area, including business model development, long-run investment choices, development of complementary and co-specialised assets, and asset orchestration. To the uninitiated, decisions in these areas might seem ad hoc because they are one-offs. Maybe the repeated need for repeated 'ad hoc' decisions in a given context (e.g. business model development) amounts to a sort of entrepreneurial routine requiring a creative, non-routine state of mind.

A description by Steve Jobs of the innovation process at Apple conveys the need to balance routines and the non-routine creative capabilities of the organisation:

Apple is a very disciplined company and we have great processes. But that's not what it's about. Process makes you more efficient. But innovation comes from people meeting up in the hallways or calling each other at 10:30 at night with a new idea, or because they realized something that shoots holes in how we've been thinking about a problem. It's ad hoc meetings of six people called by someone who thinks he has figured out the coolest new thing ever and who wants to know what other people think of his idea. And it comes from saying no to 1,000 things to make sure we don't get on the wrong track or try to do too much. We're always thinking about new markets we could enter, but it's only by saying no that you can concentrate on the things that are really important. (cited in Burrows 2004)

Jobs seems to say that, while Apple's ordinary capabilities are based in processes, its product development is a looser set of activities and non-routine cognition. Parts of this process might appear ad hoc, but they collectively amount to an extremely valuable capability that is ultimately governed by top management decisions about which products to pursue.<sup>1</sup>

Winter himself seems to have come some distance towards accepting that higher order capabilities encompass not just routines but also managerial decisions. In a 2017 article, he

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<sup>1</sup> Levinthal (2007) has observed that processes of path selection and resource allocation are underdeveloped in evolutionary economics. Resource allocation (part of asset orchestration) is a dynamic capability (Lovallo, Brown, Teece and Bardolet 2020).

explicitly discussed the distinction between what he calls System 1 (automatic routines) and System 2 (deliberative decisions), adapted from concepts introduced in the psychology research of Daniel Kahneman (2011). In developing his own version with respect to dynamic capabilities, Winter noted that, 'If, hypothetically, I were to pursue it, I would still be arguing for tuning the System 1 emphasis up a little and System 2 down a little, relative to Teece' (Winter 2017, p.73). In this paper I am, of course, suggesting that one tunes the System 2 emphasis up — at least in environments of deep uncertainty or VUCA (volatility, uncertainty, complexity and ambiguity).

## How much room for entrepreneurship?

The managerial decisions behind dynamic capabilities require a distinctive state of mind: that of an entrepreneur. In their 1982 book, Nelson and Winter quote William Baumol to the effect that mainstream economic theory 'offers us no promise of being able to deal effectively with the description and analysis of the entrepreneurial function' (Baumol 1968, p.68 cited by Nelson and Winter 1982, p.32). While their purpose is to argue that the passive maximisation of neoclassical economics is a delusion, they are more interested in the bounded rationality of the manager than in the role of the entrepreneur. In fact, entrepreneurs are scarcely mentioned again, apart from a brief discussion of Schumpeter (p. 277), where they are acknowledged as the agents within the economic system who drive technical progress. But we are a long way from a description, much less an analysis, of the entrepreneurial function.

Interestingly, in an essay that Winter wrote in the 1960s, but that was not published until 2006,<sup>2</sup> he restates Schumpeter's view of the entrepreneur as 'the leader who leads the firm to new techniques... the carrying out of new combinations.' There is then a direct quote from Schumpeter: 'Carrying out a new plan and acting according to a customary one are as different as making a road and walking on it.' (Schumpeter 1934/1949, p.85).

Clearly, Schumpeter saw the entrepreneurial function in the economy as different from the routine one. Yet Winter claims (2006, p.137) that Schumpeter sees 'the essential *continuity* between these instances of dramatic innovation and the smallest sort of adaptation to changing conditions' (emphasis in the original). The citation he provides, however, shows something quite different. Schumpeter is hypothesising not about activities like innovation and adaptation but about the distribution of skills. He suggests that entrepreneurial skill, which he likens to singing (everyone can do it at least a little bit, even if only badly), is distributed among people along something like a normal distribution. Schumpeter notes that, even if the exact cut-off points is hard to identify, there is a material difference between the best and the rest. In the words of his analogy:

Only in this [top] quarter are we struck in general by the singing ability, and only in the supreme instances can it become the characterising mark of the person. Although practically all men can sing, singing ability does not cease to be a distinguishable characteristic and attribute of a minority. (Schumpeter 1934/1949, p.82, fn2)

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<sup>2</sup> I and my *Industrial and Corporate Change* co-editor Giovanni Dosi recognised the importance of this classic, but unpublished, RAND working paper and, with Winter's concurrence, used our editorial authority, for the first time in the journal's history, to have it published.



Thus, where Winter sees continuity, Schumpeter sees a difference in kind. Making a road is quite different from walking on one. This is not just a matter of comparing a high-order routine to a simpler one.

By emphasising continuity, Winter has essentially removed the entrepreneur from Schumpeter. His concern, at least in that essay, was in how production methods change, not in how firms prepare for the future and look for the next big thing. In capabilities terms, this is the difference between ordinary and dynamic capabilities.

## What great entrepreneurial management looks like

In this regard, it is instructive to examine the approaches/heuristics that animate one of the greatest living entrepreneur-managers, Elon Musk. As reported by blogger Tim Urban (2015), who interviewed Musk extensively, Musk refers to one of his key habits of mind as 'reasoning from first principles':

I think generally people's thinking process is too bound by convention or analogy to prior experiences. But that's just a ridiculous way to think. You have to build up the reasoning from the ground up — 'from the first principles' is the phrase that's used in physics. You look at the fundamentals and construct your reasoning from that, and then you see if you have a conclusion that works or doesn't work, and it may or may not be different from what people have done in the past.

According to Urban, after Musk reasons out his goals for a project and a strategy, '[h]e tests... them, continually, and adjusts them regularly based on what he learns.'

Urban contrasts Musk's way of thinking with how most people deal with the world as 'the difference between a cook and a chef'. Cooks practise routines. Chefs innovate:

The chef reasons from first principles and for the chef, the first principles are raw edible ingredients. Those are her puzzle pieces, her building blocks, and she works her way upwards from there, using her experience, her instincts, and her taste buds. The cook works off of some version of what's already out there — a recipe of some kind, a meal she tried and liked, a dish she watched someone else make.

As it happens, Winter (2006) also used the 'cook' metaphor. Initially, he focuses on the need to combine inputs with appropriate human capital, but he also considers innovation:

Talented cooks can create new dishes by thinking up a new taste and then writing the recipe; talented composers can hear their music before they write down the required inputs of violin notes and horn notes; talented engineers can develop an idea about the physical basis for a new device into a detailed design. In all of these cases, the talent involved includes a sweeping grasp of the behavior of the relevant materials under a very wide range of conditions. Without actually baking the cake or playing the symphony or building the device, tentative solutions to the problem can be 'tried out' and modified or rejected as necessary. There is no simple answer to the question of where this knowledge comes from. Some of it — the engineer's understanding of physical laws or the composer's understanding of harmony — is theoretical knowledge. Some of it is the fruit of long personal experience with the general class of problems involved, and some is obtained from reports of the experience of others, or direct contact with their work. (Winter 2006, p.133)

Winter clearly saw the difference between a chef (or 'talented cook') and a plain cook who only knows how to follow recipes. But his interest is in different levels and types of productive knowledge within the firm, not in how the talented cook can start a new business.

Musk has noted that reasoning from first principles isn't desirable or necessary at all times. Most of the time, 'copying what other people do with slight variations' is enough. 'Otherwise, mentally, you wouldn't be able to get through the day' (cited in Popomaronis 2020). Put differently, routines help to accomplish day-to-day work and economise on bounded rationality. But strategy work requires a different approach. Teece, Peteraf and Leih (2016) make a case for abductive reasoning, which is close to Musk's reasoning from first principles, at least as he applies it.

Of course, reasoning from first principles, or abductive reasoning, could be thought of as a routine, but this misrepresents the strategy process, which, if written down, would look something like, 'Gather all the facts, have a brilliant insight, work really hard, repeat.' The problem with this is that not every entrepreneur-manager can have insights on demand, although a select few seem to. There are creative and insight-dependent components that cannot be routinised.

Entrepreneurship isn't an adaptation to environmental conditions; it's the making of 'new combinations' (Schumpeter 1942). Musk, Steve Jobs at Apple, Jeff Bezos at Amazon, or Page and Brin at Google weren't adapting to environmental changes, either at the founding of their companies or as the years passed. They were building futures they had envisioned.

The forging of organisational routines and capabilities may occur after investment decisions are made. Existing routines (or their absence) need not constrain the decision space. Although it might have been safer to partner with an existing carmaker, Musk created his own routines for Tesla's ordinary capabilities. Blending Japanese-style continuous improvement with Silicon Valley culture, he approached the factory as if it were a software program (Teece 2018).

Tenacity, unwavering self-confidence, optimism and a tolerance for stress are traits of successful entrepreneurs (Crane and Crane 2007; Rauch and Frese 2007). Passion for work, i.e. a willingness to put in the long hours for an extended period that a venture requires, is another important feature (Baum and Locke 2004).

There are, of course, risks in relying on a particular talented individual, especially if those talents don't translate into a set of replicable internal routines. It's therefore important that an entrepreneurial state of mind and related skills are disseminated and encouraged throughout the organisation. In 2008, before Steve Jobs' second medical leave, he established an internal business school at Apple in which academics were brought in to prepare cases about how key past decisions, such as the creation of the Apple Store, were reached (Lashinsky 2011). By having executives teach these cases to the company's managers, Apple's high-level routines and top management processes are propagated among its current and future leaders.

Entrepreneurial thinking can also be embedded in the organisation's culture and repeatedly demonstrated and rewarded. This applies to dynamic capabilities more generally. The environmental scanning that supports 'sensing', for example, should be distributed throughout the organisation, with open communication channels to the appropriate decision-makers.

## Entrepreneurial managers in the dynamic capabilities framework

Obviously, not everyone who starts a new enterprise wields the same abilities as Elon Musk or Steve Jobs, but there are many talented entrepreneurs, some quiet at their work, others quite noisy about it. Entrepreneurial managers also operate within established firms (Teece 2007, 2016; Helfat and Peteraf 2015).

By 'entrepreneurial manager' I mean a particular combination of skills. Top and middle managers in an organisation can be called on to deploy three types of role, described further in Table 1: operational, entrepreneurial and leadership. These are each aspects of managerial dynamic capabilities (Adner and Helfat 2003). The roles can be distributed in many ways. For example, they may be explicitly divided across job titles or, in a small startup, they may be combined in a single individual. It is the combination of entrepreneurship and leadership that I call 'entrepreneurial management'.<sup>3</sup>

This is not to imply that entrepreneurship within an established organisation is the same as entrepreneurship in a new venture. The launch of a firm-within-a-firm, for example, places special challenges on top management's ability to handle existing and new business 'ambidextrously' (O'Reilly and Tushman 2004, 2008). This requirement adds another layer of difficulty on the launch of a new business and access to the resources of the established business can drag down the new one through 'diseconomies of scope' (Bresnahan, Greenstein and Henderson 2011). As Bresnahan et al. point out in their detailed analysis of IBM's missteps in the personal computer market and Microsoft's in Internet infrastructure software, 'the two incumbent firms had no difficulty building the raw organizational capabilities necessary to compete in the new markets' yet both were tripped up by 'very considerable organizational conflict' between the new business and the old (Bresnahan, Greenstein and Henderson 2011, p.266). Their inability to manage so as to allow both old and new businesses to advance marks a failure of top management's transformation capabilities.

Bresnahan et al.'s analysis also makes clear that strong organisational capabilities are not sufficient on their own to build and maintain competitive advantage. The dynamic capabilities for transforming the organisation in a way that allows new, potentially incompatible, initiatives to thrive are indispensable.

Evolutionary economics has not entirely ignored the manager, arguing that the 'intentionality and deliberation' implicit in the development of capabilities 'provides a bridge between the predominantly descriptive concerns of evolutionary theory and the prescriptive analysis of firm strategy' (Dosi, Nelson and Winter 2000, p.12). But the dynamic capabilities view makes the role of managers explicit and more prominent. Sensing, seizing and transforming, the main categories of dynamic capabilities, while reliant on organisational routines, are coordinated and guided by entrepreneurial managers. In the dynamic capabilities view, 'the entrepreneur/manager function... is in part Schumpeterian (the entrepreneur introduces novelty and seeks new combinations) and in part evolutionary (the entrepreneur endeavors to promote and shape learning)' (Augier and Teece 2009, p.418). One could add that the entrepreneurial manager leads transformation when that becomes necessary.

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<sup>3</sup> Arguably, I could have used 'entrepreneurial management and leadership' to keep equal stress on insight and implementation. I chose to use 'entrepreneurial management' for brevity.

Table 1: Three roles of managers

	Operational role	Entrepreneurial role	Leadership role
<b>Responsibilities</b>	Planning and budgeting	Sensing and seizing	Propagating vision and values
<b>Activities</b>	Organising and staffing	Orchestrating resources	Aligning people with strategy
<b>Levers</b>	Control and problem-solving	Investing in R&D, developing new business models	Motivating people
<b>Goals</b>	Technical efficiency and predictable results	Competitive advantage	Unity of purpose

Source: Teece (2016)

Entrepreneurship and leadership are critical for the performance of the business enterprise and are difficult to teach. Whereas the operational role lends itself to routines and standard operating procedures, the entrepreneurial role is not readily amenable to routinisation. Neither is leadership, which is required in order to unite people around a shared purpose, and instill or sustain a culture of flexibility, innovation and change. As Baumol (1968, p.65) notes, leadership is virtually absent from the mainstream theory of the firm. It is also absent from evolutionary economics.

In the dynamic capabilities view of the firm, entrepreneurial managers are central to the firm's evolution, because they have the ability to decide whether existing capabilities remain in the firm and whether new ones should be added. The continuity and evolution of the particular set of operational capabilities that a firm has at a point in time are important to the running of the firm, but they are of secondary importance for its long-term survival.

Entrepreneurial management requires a rare mix of creativity and rigor: a vision of the future, a commitment to hypothesis testing, a love of risk and sensitive people skills. Naturally not all managers bring the same level of skill to bear. Poor managers can hinder a firm's development rather than propel it forward (Rosenbloom 2000). There is, indeed, a normative quality to the dynamic capabilities account of strategic renewal. Yet it is positive in that all organisations do some sort of sensing, seizing and transforming, even if they don't do it well or in an organised fashion.

The chief implication of the differing treatment of the entrepreneurial manager between dynamic capabilities and evolutionary economics is the relative emphasis on innovation and change. Major change can happen in evolutionary models, but it has a large random component. In the dynamic capabilities framework, it's an objective. Nelson and Winter see dynamic capabilities and innovation as just so many routines: 'We view firms as possessing routines which operate to modify over time various aspects of their operating characteristics' (Nelson and Winter 1982, p.17). But revolution cannot be readily routinised.

# Dynamic capabilities: Evolution with design, purpose and strategy

## 6.1 Contributions to dynamic capabilities by evolutionary economics

Evolutionary thinking has been influential in strategic management and helped undergird the dynamic capabilities framework, particularly in its first iteration (Teece, Pisano and Shuen 1997). In that early version, I focused on the role of history in shaping the extent to which a firm can reconfigure its assets and concluded that a firm's 'evolutionary path... is often rather narrow' (p.524). The initial definition of dynamic capabilities as 'the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments' (Teece, Pisano and Shuen 1997, p.516) echoes the Nelson and Winter concept of 'routines which operate to modify over time various aspects of [firms'] operating characteristics' (Nelson and Winter 1982, p.17). But, even in 1997, dynamic capabilities were already straining at the leash, being described further as 'an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions' (Teece, Pisano and Shuen 1997, p.516). Path dependencies are a context, but not strictly a constraint.

Dynamic capabilities has roots in evolutionary economics, but also goes beyond it. Both frameworks share common ancestors, drawing on the same behavioural economics underpinnings (e.g. Cyert and March 1963). The heritage of dynamic capabilities from the behavioural theory of the firm (Cyert and March 1963; Gavetti, Greve, Levinthal and Ocasio 2012) includes 'organizational expectations' and search (or 'sensing', in dynamic capabilities terms). The Cyert and March concepts of 'organizational choice' and 'organizational control' align with 'seizing' in dynamic capabilities, and the behavioural notion of adaptation captures some elements of the dynamic capabilities for 'transformation'. In general, where behaviourists (and evolutionists) emphasise limitations such as bounded rationality on human decisions, the dynamic capabilities framework also emphasises the possibility of devising new businesses, as well as new futures for old businesses. To some extent, managerial epiphanies parallel scientific breakthroughs. As Einstein once noted:

The mind can proceed only so far upon what it knows and can prove. There comes a point where the mind takes a leap — call it intuition or what you will — and comes out upon a higher plane of knowledge, but can never prove how it got there. All great discoveries have involved such a leap.' (cited in *LIFE* 1955, p.64)

That's not to say there isn't a process involved, although it may not be a routine. Einstein also said that, 'Intuition is nothing but the outcome of earlier intellectual experience' (cited in Isaacson 2007, p.113).

Dynamic capabilities and evolutionary economics also each draw on concepts from Austrian economic thinking, particularly the work of Schumpeter, but also Kirzner, Hayek and others. Teece is more Austrian than Nelson and Winter in the sense that dynamic capabilities embrace discontinuous change, emergent order and 'knowledge of the particular time and place' as the norm in VUCA environments.

Change does, of course, exist in evolutionary models of the firm, but it tends to be incremental and often unintentional. Firm capabilities can undergo drift, including depreciation, possibly due to employee turnover (Argote 1996). Capabilities may be transferred and replicated, sometimes imperfectly (Teece 1977; Winter, Szulanski and Jensen 2012). Such drift/mutation is an integral part of evolutionary theorising.

By contrast, large, deliberate step-function changes resulting from new combinations in the minds of entrepreneurial managers don't fit all that easily into evolutionary thinking. Winter (2006) noted the difficulties this poses for building a model of the firm:

Just as the fragmentation of knowledge in the firm makes innovation difficult and the consequences of attempted innovation unpredictable it tends to frustrate the economist who wants to predict the lines that innovation will take. ... 'Mere managers' may behave predictably, entrepreneurs (and the organizations led by them) do not (Winter 2006, p.139)

Subsequent to the earliest dynamic capabilities articles, I have taken a broader approach, constructing a dynamic capabilities framework that embraces the potential for firms to effectuate more fundamental, discontinuous organisational transformations (Teece 2007, 2014).

Entrepreneurial managers can search not just locally, but widely, for new opportunities and introduce routines more distant from existing ones than are typically contemplated in the evolutionary literature. Call it evolution with design or, even better, evolution with design, purpose and strategy.

## 6.2 Narrow view of innovation and change in evolutionary economics

In evolutionary models, change is typically invoked with the word 'innovation'. Purposeful discontinuities makes organisations harder to model, but such innovations are the stuff of economic growth.

Evolutionary innovations are generally modelled along a single dimension (usually technology) in which change occurs, when in fact there are many ways in which organisations can change, including their internal structure, organisational boundaries, business models, market positioning and so on. Nelson has acknowledged as much:

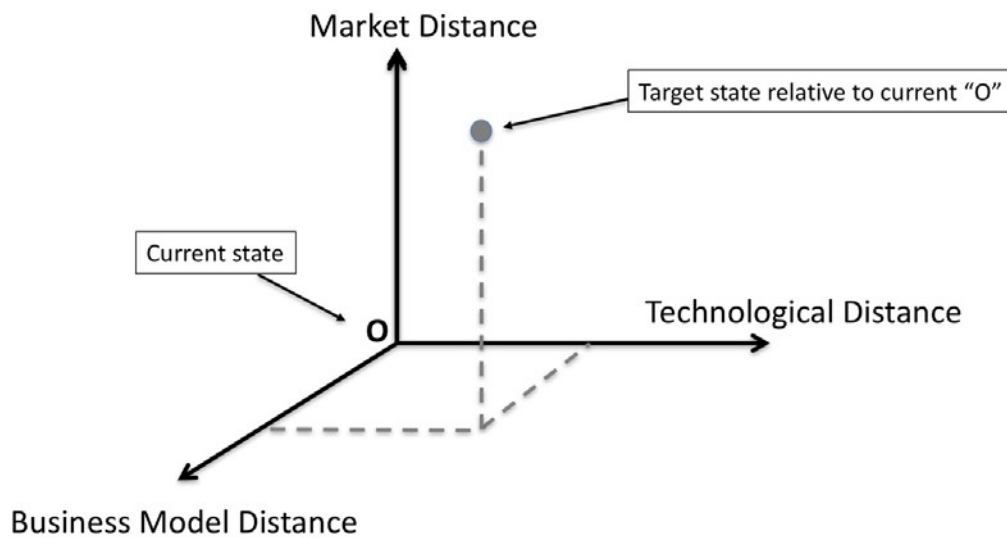
While most of the research by evolutionary economists, and scholars more broadly, on innovation has been oriented to technological innovations, increasingly organizational and institutional innovation is on the agenda (Nelson 2018, p.24)

The unidimensionality of innovation in evolutionary economics can be seen in NK models, a common tool in the discipline. The NK concept of distance is reductive, because it compares sets of binary choices (e.g. Levinthal 1997). In mathematical terms, it's Hamming distance rather than Euclidean distance. It gives no insight into how difficult any individual change will be. Stuart and Podolny (1996) operationalised a quantitative metric for technological distance over an economic space of production techniques, but it's not clear this can be generalised to other variables.

In a recent theoretical paper (Teece 2019a), I argued for the need to consider additional dimensions. I defined organisational change as occurring in a space dimensionalised by technology, markets and business models (see Figure 1). The difficulty and, most likely, cost of executing a shift to a new point in this space increases with distance from the firm's existing capability set. While the assessments of the distances involved are necessarily qualitative, the structure forces decision-makers to keep in mind the multidimensionality of the task at hand.

I might well have added a dimension of time, because the pecuniary and other costs of making a significant change are likely to be inversely related to the amount of time over which the change must be made. The gravitational pull of the existing way of doing things makes it hard for new ways to achieve escape velocity — and most likely raises their implementation cost.

Figure 1: The dimensions of distance for transformation



Source: Teece (2019a)

The trade-off between the cost and speed of change can be mitigated to some extent by advanced preparation in the form of creating a culture of innovation and resilience. An open, agile culture cannot be created overnight. Like absorptive capacity, it builds over time and lowers the cost – and expands the range – of future strategic choices (Zahra and George 2002). Imposition of radical change in an organisation that is not suitably prepared is likely to create problems that can potentially undermine strategic renewal (Teece 2019b).

### 6.3 Dynamic capabilities and evolutionary economics reimaged

As important as how firms can change is why they change. This is where dynamic capabilities can provide guidance. The key clusters of activities that make up dynamic capabilities can be categorised as sensing, seizing, and transforming (Teece 2007, 2012). As explained above, dynamic capabilities are as dependent on managerial decisions as on organisational routines. As elastic as the concept of routines may be (Nelson and Winter 1982, p.115), the concept is not fully up to the task that the dynamic capabilities framework requires.

The gap is most evident in sensing. The mainstream evolutionary equivalent of sensing is 'search'. The tradition that has developed in evolutionary economics, particularly with respect to technology, has been that search is primarily 'local'. Nelson and Winter (1982, p.409) called for more research on 'alternative' (i.e. non-local) strategies, but much of the work in the evolutionary field has privileged the pull of legacy over the push of strategy (Laursen 2012).

In the population-level NK models of Levinthal and colleagues, search is typically modelled in simulations as random changes in one or more dimensions (e.g. Levinthal and Posen 2007). This allows comparisons of local and non-local search strategies, but at the expense of abstracting from how strategies are formed.

By contrast, sensing, in the dynamic capabilities context, is the ability, under Knightian uncertainty, to either recognise opportunities before they are fully apparent or, in some cases, create new ones (Helfat and Peteraf 2015). While there are underlying routines, the signals that

feed into them should come from near and far, leaving it to the relevant decision-maker(s) to make sense from them, as a prelude to making strategy.

There is no obvious place for seizing in evolutionary economics. In the dynamic capabilities framework, seizing involves the innovation of business models, the filling of capability gaps, the achievement of alignment, the setting of firm boundaries and the making of investment commitments. Aspects of these activities can be found by reading between the lines of the evolutionary literature, but they are certainly not given the full attention they merit in terms of their strategic importance. More importantly, evolutionary economics gives too little attention to the dimension of time, particularly the urgency needed for effective seizing.

As for transforming, evolving organisations can adopt new routines, but the emphasis for evolutionists is on trial-and-error learning (Winter 2000). The consequential decisions about what capabilities will be needed to execute a new business model and whether to make or buy those that are missing are exogenous. As the following quote from Jeff Bezos, Amazon CEO, indicates, entrepreneurial thinking and evolutionary thinking can be at cross purposes:

Companies get skills-focused, instead of customer-needs focused... A much more stable strategy is to start with 'what do my customers need?' Then do an inventory of the gaps in your skills. Kindle is a great example. If we set our strategy by what our skills happen to be rather than by what our customers need, we never would have done it. We had to go out and hire people who know how to build hardware devices and create a whole new competency for the company. (Bezos 2008)

The Teeceian view of dynamic capabilities allows proactive managers to effectuate organisational change in anticipation of environmental change, not waiting to adapt to changes after they occur. The development of firms is not by any means completely path-dependent or limited to best practice or equifinal routines. Instead, distinctive, higher order routines, rules of thumb, and/or managerial approaches lead to distinctive evolutionary paths. Excellence not only in search ('sensing' in dynamic capabilities terms), but also in sensemaking (Teece 1998) affords the firm the opportunity to stay ahead of competitors.

An overarching function of top management in the dynamic capabilities framework is 'asset orchestration' (Teece 2007, 2014).<sup>4</sup> Orchestration encompasses not only routines and other resources of the firm, but also assets outside the firm, via strategic alliances, ecosystems, etc. Orchestration aims at alignment of all assets and, when successful, can itself be a source of value. Evolutionary theory is silent with respect to the asset structure of the firm and related alignment opportunities. Alignment is not routine, it requires artful coordination and continual attention.

Orchestration and alignment also imply integration. As Winter has written, 'The difficulties standing in the way of adaptive or innovative change have to do with the fragmentation of relevant knowledge, both of operations and concepts' (Winter 2006, p.138). The ability to integrate knowledge across large, or even smaller, organisations

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<sup>4</sup> This is perhaps better thought of as 'wild orchestration' as compared to tightly choreographed coordination. In an orchestra, the conductor sticks to the score. The orchestration in dynamic capabilities is more akin to jazz, where there is a leader, but all elements are also creating and responding in real time. As Reed Hastings, CEO of Netflix, put it in the conclusion to *No Rules* (Hastings and Meyer 2020):

To build a team that is innovative, fast and flexible, keep things a little bit loose. Welcome constant change. Operate a little closer toward the edge of chaos. Don't provide a musical score and build a symphonic orchestra. Work on creating those jazz conditions and hire the type of employees who long to be part of an improvisational band. When it all comes together, the music is beautiful.



may come down more to their culture of internal openness and shared sense of purpose than to any identifiable routine. Culture and vision must, in turn, be fostered and reinforced by top management.

Another significant component of the dynamic capabilities framework that is exogenous to evolutionary economics is strategy. Strategy-making processes are conceptually separate from dynamic capabilities, but both are core, interacting elements of the broader dynamic capabilities framework (Teece 2014). Leveraging dynamic capabilities for competitive advantage, particularly in large organisations, requires good strategy, bold (and smart) decisions and also leadership skills. These are hard to routinise.

The strategy element in the dynamic capabilities framework draws on Richard Rumelt's strategy kernel, which holds that a good strategy generally involves a diagnosis (problem definition and analysis), a guiding policy (general approach adopted) and a coherent plan for actions to be taken (Rumelt 2011). This sequence is slightly suggestive of a high-order routine, but to view it that way is to distract from the individual decisions that must ultimately be made.

To the extent that strategy has been examined through an evolutionary lens, it has been largely a bottom-up model. Strategy is seen to originate with front-line managers, and is then filtered and shaped by middle and top managers within the boundaries of the context set by top management (Noda and Bower 1996). An internal selection process ensues within the firm as strategic initiatives compete for resources.

The dynamic capabilities framework tends to view strategy with a top-down perspective, while still recognising the critical roles that lower-level managers play in (1) collecting and communicating signals as inputs for managerial sensing and (2) translating and implementing strategy once it has been adopted (Lee and Teece 2013). As with other aspects of the dynamic capabilities framework, the emphasis on what Winter (2017) calls System 2 decisions by top management are emphasised over the underlying System 1 process.

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## Conclusion

In this brief paper, I've discussed how evolutionary economics is one of the foundational pillars of dynamic capabilities. Another of these pillars is the entrepreneurial perspective, which is more focused on the creation of discontinuities, i.e. the pioneering of new markets (Penrose 1959; Denrell, Fang and Winter 2003).

Each brings something different. While evolutionary models suggest adaptation of firms to their environment, the entrepreneurial approach promotes the ability of firms to shape that environment. The unification of these perspectives in the dynamic capabilities framework leads to a recognition of the ability/need to change while accounting for underlying continuities.

It is my hope that, by viewing evolutionary economics within the broader context of the dynamic capabilities framework, evolutionary economists will be better able to handle a fuller range of innovations and non-routine entrepreneurial decisions. It may be time for evolutionary theorists to abandon the belief that routines or meta-routines can undergird the entirety of dynamic capabilities. Creative managerial and entrepreneurial acts (e.g. creating new markets) that drive economic growth and change are, by their nature, strategic and non-routine, even though there may be underlying principles that guide the choices.

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## References

- Adler, P. (1993). The learning bureaucracy: New United Motor Manufacturing, Inc. *Research in Organizational Behavior*, 15, 111–194.
- Adler, P. S., Goldoftas, B. and Levine, D. I. (1999). Flexibility versus efficiency? A case study of model changeovers in the Toyota production system. *Organization Science*, 10(1), 43-68.
- Adner, R. and Helfat, C. E. (2003). Corporate effects and dynamic managerial capabilities. *Strategic Management Journal*, 24(10), 1011-1025.
- Argote, L. (1996). Organizational learning curves: Persistence, transfer and turnover. *International Journal of Technology Management*, 11(7-8), 759-769.
- Arndt, F. and Pierce, L. (2018). The behavioral and evolutionary roots of dynamic capabilities. *Industrial and Corporate Change*, 27(2), 413-424.
- Augier, M. and Teece, D. J. (2009). Dynamic capabilities and the role of managers in business strategy and economic performance. *Organization Science*, 20(2), 410-421.
- Baum, J. R. and Locke, E. A. (2004). The relationship of entrepreneurial traits, skill and motivation to subsequent venture growth. *Journal of Applied Psychology*, 89(4), 587.
- Baumol, W. J. (1968). Entrepreneurship in economic theory. *American Economic Review*, 58(2), 64-71.
- Becker, M. C., Lazaric, N., Nelson, R. R. and Winter, S. G. (2005). Applying organizational routines in understanding organizational change. *Industrial and Corporate Change*, 14(5), 775-791.
- Bezos, J. (2008). Bezos on innovation. *Bloomberg BusinessWeek*, 16 April 2008. Available at: <https://www.bloomberg.com/news/articles/2008-04-16/bezos-on-innovation> (accessed December 27, 2020).
- Bloom, N., Genakos, C., Sadun, R. and Van Reenen, J. (2012). Management practices across firms and countries. *Academy of Management Perspectives*, 26(1), 12-33.
- Bresnahan, T. F., Greenstein, S. and Henderson, R. M. (2011). Schumpeterian competition and diseconomies of scope: Illustrations from the histories of Microsoft and IBM. In J. Lerner and S. Stern (eds.), *The Rate and Direction of Inventive Activity Revisited*. Chicago, IL: University of Chicago Press, 203-271.
- Burrows, P. (2004). The seed of Apple's innovation. *Businessweek.com*, 12 October 2004. Retrieved from: [http://www.businessweek.com/print/bwdaily/dnflash/oct2004/nf20041012\\_4018\\_db083.htm](http://www.businessweek.com/print/bwdaily/dnflash/oct2004/nf20041012_4018_db083.htm) (no longer available).
- Crane, F. G. and Crane, E. C. (2007). Dispositional optimism and entrepreneurial success. *The Psychologist-Manager Journal*, 10(1), 13-25.
- Cyert, R. M. and March J. G. (1963). *A Behavioral Theory of the Firm*. Englewood Cliffs, NJ: Prentice-Hall.
- Denrell, J., Fang, C. and Winter, S. G. (2003). The economics of strategic opportunity. *Strategic Management Journal*, 24(10), 977-990.
- Dosi, G., Nelson, R. R. and Winter, S. G. (2000). Introduction: The nature and dynamics of organizational capabilities. In G. Dosi, R. R. Nelson and S. G. Winter (eds.), *The Nature and Dynamics of Organizational Capabilities*. Oxford, UK: Oxford University Press.

- Fruin, W. M. and Nishiguchi, T. (1991). The Toyota Production System: Its Organizational Definition in Japan. *Economic Review*, 42(1), 42-55.
- Gavetti, G., Greve, H. R., Levinthal, D. A. and Ocasio, W. (2012). The behavioral theory of the firm: Assessment and prospects. *Academy of Management Annals*, 6(1), 1-40.
- Gratton, L. and Ghoshal, S. (2005). Beyond best practice. *MIT Sloan Management Review*, 46(3), 49-57.
- Hastings, R. and Meyer, E. (2020). *No Rules Rules: Netflix and the Culture of Reinvention*. New York: Penguin Press.
- Helfat, C. E. (2018). The behavior and capabilities of firms. In R. R. Nelson, G. Dosi, C. E. Helfat, A. Pyka, S. G. Winter, P. P. Saviotti, K. Lee, F. Malerba and K. Dopfer, *Modern Evolutionary Economics: An Overview*. Cambridge, UK: Cambridge University Press, 85-103.
- Helfat, C. E. and Peteraf, M. A. (2015). Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal*, 36(6), 831-850.
- Helfat, C. E. and Winter, S. G. (2011). Untangling dynamic and operational capabilities: Strategy for the (n)ever-changing world. *Strategic Management Journal*, 32(11), 1243-1250.
- Hoopes, D. G. and Madsen, T. L. (2008). A capability-based view of competitive heterogeneity. *Industrial and Corporate Change*, 17(3), 393-426.
- Isaacson, W. (2007). *Einstein: His Life and Universe*. New York: Simon and Schuster.
- Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.
- Kenney, M. and Florida, R. (1991). How Japanese industry is rebuilding the rust belt. *Technology Review*, 94(2), 24-33.
- Lashinsky, A. (2011). How Apple works: Inside the world's biggest startup. *Fortune* (9 May 2011). Available at: <https://fortune.com/2011/05/09/inside-apple/> (subscription required).
- Laursen, K. (2012). Keep searching and you'll find: What do we know about variety creation through firms' search activities for innovation? *Industrial and Corporate Change*, 21(5), 1181-1220.
- Lee, S. and Teece, D. J. (2013), The functions of middle and top management in the dynamic capabilities framework. *Kindai Management Review* 1, 28-40.
- Levinthal, D. A. (1997). Adaptation on rugged landscapes. *Management Science*, 43(7), 934-950.
- Levinthal, D. A. (2007). Bringing selection back into our evolutionary theories of innovation. In S. Brusoni and F. Malerba (eds.), *Perspectives on Innovation*. Cambridge, UK: Cambridge University Press, 293-307.
- Levinthal, D. and Posen, H. E. (2007). Myopia of selection: Does organizational adaptation limit the efficacy of population selection? *Administrative Science Quarterly*, 52(4), 586-620.
- LIFE*. (1955). Death of a genius (2 May 1955). 38(18), 61-64.
- Lippman, S. A. and Rumelt, R. P. (1982). Uncertain imitability: An analysis of interfirm differences in efficiency under competition. *The Bell Journal of Economics*, 418-438.
- Lovallo, D., Brown, A. L., Teece, D. J. and Bardolet, D. (2020). Resource re-allocation capabilities in internal capital markets: The value of overcoming inertia. *Strategic Management Journal* 41(8), 1365-1380.

- Nelson, R. R. (1991). Why do firms differ and how does it matter?. *Strategic Management Journal*, 12(S2), 61-74.
- Nelson, R. R. and Sampat, B. N. (2001). Making sense of institutions as a factor shaping economic performance. *Revista de Economía Institucional*, 3(5), 17-51.
- Nelson, R. R. (2018). Economics from an evolutionary perspective. In R. R. Nelson, G. Dosi, C.E. Helfat, A. Pyka, S. G. Winter, P. P. Saviotti, K. Lee, F. Malerba and K. Dopfer, *Modern Evolutionary Economics: An Overview*. Cambridge, UK: Cambridge University Press, 1-34.
- Nelson, R. R. and Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: Belknap Press.
- O'Reilly, C. A. and Tushman, M. L. (2004). The ambidextrous organization. *Harvard Business Review*, 82(4), 74–81.
- O'Reilly, C. A. and Tushman, M. L. (2008). Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. *Research in Organizational Behavior*, 28, 185–206.
- Penrose, E. T. (1959). *Theory of the Growth of the Firm*. Oxford, UK: Blackwell.
- Popomaronis, T. (2020). Elon Musk calls this a 'powerful, powerful way of thinking' — but is 'hard to do.' Here's how it works. Blog dated 29 February 2020. Available at: <https://www.cnbc.com/2020/02/28/billionaire-elon-musk-this-is-a-powerful-way-of-thinking-but-hard-to-do-how-it-works.html> (accessed 5 January 2021).
- Rauch, A. and Frese, M. (2007). Let's put the person back into entrepreneurship research: A meta-analysis on the relationship between business owners' personality traits, business creation, and success. *European Journal of Work and Organizational Psychology*, 16(4), 353-385.
- Rosenbloom, R. S. (2000). Leadership, capabilities and technological change: The transformation of NCR in the electronic era. *Strategic Management Journal*, 21(10-11), 1083-1103.
- Rumelt, R. (2011). *Good Strategy/Bad Strategy: The Difference and Why It Matters*. New York: Crown Business.
- Schumpeter, J. A. (1934/1949). *The Theory of Economic Development*. Translated by R. Opie, third printing. Cambridge, MA: Harvard University Press.
- Stuart, T. E. and Podolny, J. M. (1996). Local search and the evolution of technological capabilities. *Strategic Management Journal*, 17(S1), 21-38.
- Teece, D. J. (1977). Technology transfer by multinational firms: The resource cost of transferring technological know-how. *The Economic Journal*, 87(346), 242-261.
- Teece, D. J. (1998). Capturing value from knowledge assets: The new economy, markets for know-how and intangible assets. *California Management Review*, 40(3), 55-79.
- Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350.
- Teece, D. J. (2012). Dynamic capabilities: Routines vs entrepreneurial action. *Journal of Management Studies*, December 2012.
- Teece, D. J. (2014). The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. *Academy of Management Perspectives*, 28(4), 328-352.

- Teece, D. J. (2016). Dynamic capabilities and entrepreneurial management in large organizations: Toward a theory of the (entrepreneurial) firm. *European Economic Review*, 86, 202-216.
- Teece, D. J. (2018). Tesla and the reshaping of the auto industry. *Management and Organization Review*, 14(3), 501-512.
- Teece, D. J. (2019a). A capability theory of the firm: An economics and (strategic) management perspective. *New Zealand Economic Papers*, 53(1), 1-43.
- Teece, D. J. (2019b). Strategic renewal and dynamic capabilities: Managing uncertainty, irreversibilities and congruence. In A. Tuncdogan, A. Lindgreen, F. Van Den Bosch, and H. Volberda (eds.), *Strategic Renewal: Core Concepts, Antecedents, and Micro Foundations*. Routledge: New York, 21-51.
- Teece, D., Peteraf, M. and Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty and strategy in the innovation economy. *California Management Review*, 58(4), 13-35.
- Teece, D. J., Pisano, G., and Shuen, A. (1990). Firm capabilities, resources and the concept of strategy. CCC Working Paper 90-8, Center for Research in Management, University of California, Berkeley.
- Teece, D. J., Pisano, G. and Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.
- Turner, S.F. and Fern, M.J. (2012). Examining the stability and variability of routine performance: the effects of experience and context change. *Journal of Management Studies*, 49, 1407-34.
- Urban, T. (2015). The cook and the chef: Musk's secret sauce. Blog dated 6 November 2015. Available at: <https://waitbutwhy.com/2015/11/the-cook-and-the-chef-musks-secret-sauce.html#13> (accessed 5 January 2021).
- Winter, S. G. (2000). The satisficing principle in capability learning. *Strategic Management Journal*, 21(10-11), 981-996.
- Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, 24(10), 991-995.
- Winter, S. G. (2006). Toward a neo-Schumpeterian theory of the firm. *Industrial and Corporate Change*, 15(1), 125-141.
- Winter, S. G. (2017). Pursuing the evolutionary agenda in economics and management research. *Cambridge Journal of Economics*, 41(3), 721-747.
- Winter, S. G., Szulanski, G., Ringov, D. and Jensen, R. J. (2012). Reproducing knowledge: Inaccurate replication and failure in franchise organizations. *Organization Science*, 23(3), 672-685.
- Womack, J. P., Jones, D. T. and Roos, D. (1990). *The Machine That Changed the World*. New York: Rawson Associates.
- Zahra, S. A. and George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, 27(2), 185-203.

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