

Putting choice in the spotlight to advance theory on organizational adaptation to technological discontinuities

Putting choice
in the spotlight

83

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Abstract

Purpose – This paper aims to develop and argue for a new research path to advance theory on incumbent firm adaptation to discontinuous technological change. Integrating variance and process epistemologies, implications of distinguishing a firm’s capacity to adapt from their adaptive choices are highlighted.

Design/methodology/approach – The concepts and argument presented are based on an extensive review and synthesis of the literature on the phenomenon.

Findings – Distinguishing resource-based capacity variables and behavioral-based choice variables can fuel progress in the literature on incumbent adaptation to technological changes. More attention is needed on the direct, proximate determinants of what occurs in the process of adaptation, e.g. the intermediate choices to adapt, the timing of adaptive actions and the selection of a means for adapting. Work must then associate specific choices with performance outcomes to complete both sides of the mediated cause-effect model connecting characteristics of the decision issue to performance.

Originality/value – Most studies toward understanding how incumbent firms adapt to discontinuous technological innovation have used variance analyses to identify firm and technology characteristics that explain adaptation outcomes. Focusing on characteristics and content, however, does not adequately explain why or how firms adapt. Scholars thus continue to lament the lack of clear, practical theory. I contend one heretofore unaddressed reason for this dissatisfaction is that too much of the research base neglects the importance of understanding choices and the factors affecting them.

Keywords Technology adoption, Organizational adaptation, Strategic choice, Discontinuous technological innovation, Incumbent adaptation to technological change

Paper type Viewpoint

I imagine ancient Greek philosophers would have liked to see all scholarly works begin with one of their quotes. Thus, I begin. Heraclitus, emphasizing that change is the one constant in the universe, stated (in other words) “no man steps in the same river twice.” Rephrased for organizational studies, this means “no firm operates in the same environment twice.” If he were with us today, Heraclitus would be making good money writing books and giving talks on management in our era of rapid and dramatic technological change.



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Change, and adaptation to it, gets a lot of attention from management and organizational scholars. We study topics such as organizational adaptation and change (Hannan & Freeman, 1984; Hrebiniak & Joyce, 1985; Weick & Quinn, 1999), strategic change and renewal (Agarwal & Helfat, 2009; Rajagopalan & Spreitzer, 1997), microfoundations of change (Aggarwal, Posen, & Workiewicz, 2017; Barreto, 2010; Helfat & Martin, 2015; Teece et al., 1997), organizational ambidexterity (Raisch & Birkinshaw, 2008), and organizational and strategic flexibility (Hitt, Keats, & DeMarie, 1998; Volberda, 1997). Technological innovations, a key driver of change, have been a major topic in the strategic management field since its very beginning (Cooper & Schendel, 1976). Because they may be the most severe and challenging type of exogenous change confronting existing firms, a sizeable portion of this literature deals with how incumbent firms adapt to discontinuous and potentially industry-transforming technological innovations (Ansari & Krop, 2012; Hill & Rothaermel, 2003; Meyer, Brooks, & Goes, 1990; Roy & Sarkar, 2016). Artificial intelligence, nanotechnology, additive manufacturing, renewable energy, advanced robotics, autonomous vehicles, personalized medicine, virtual and augmented reality. . . these are just a few examples of technological discontinuities reshaping entire industries (Manyika et al., 2013). There are, of course, many different forces of change related to firm adaptation. The severity and increasing frequency of discontinuous technological change, however, makes this phenomenon a relevant and useful focus for examining firm adaptation.

Research on incumbent adaptation to technological change has been a vibrant field for decades. Yet scholars continue to lament that research has failed to coalesce around an adequate holistic framework (Ansari & Krop, 2012; Eggers & Park, 2018). Most research delivers either very narrow explanations or overly complex contingency frameworks and thus fails to provide a general framework for clear, practical guidance (Eggers & Park, 2018). Having done a comprehensive review of the empirical research on this topic, I agree with Eggers and Park's (2018) assessment. I disagree, however, with their conclusion that the best path forward is for continued development of complex contingency perspectives. As an alternative path, I propose that more value for theory and practice will be achieved by slightly shifting the dominant paradigm underlying research on this phenomenon.

Ann Langley describes two main research paradigms: variance thinking, which seeks correspondence between dependent and independent variables, and process thinking which accounts for the realistic feature of time and how variables evolve (Gehman et al., 2018). Most studies on incumbent adaptation, like a great deal of strategy research overall, follow variance thinking and strive to identify firm characteristics that correlate with performance outcomes, i.e. successful adaptation. Nuance in variance approaches comes when differing contexts are accounted for. Thus, the most recent comprehensive literature reviews (Ansari & Krop, 2012; Eggers & Park, 2018) build theory on the role of firm-level variables within contingency frameworks accounting for the nature of a specific technology and external environment.

The variables examined as predictors of adaptation are rather consistent throughout the literature (see Appendix for a summary). For example, numerous scholars have emphasized the relationship between an incumbent's successful adaptation and their possession of complementary assets, relevant knowledge and skills and dynamic capabilities. Multiple studies identify characteristics of an incumbent's internal structure, external networks and stakeholder relationships as antecedents of successful adaptation. Others, albeit a stark minority, examine incumbent adaptation through a cognitive lens. The long-standing dominance of variance approach studies in this literature has resulted in a rather clear description of what characteristics of an incumbent are associated with successful adaptation. Yet, a search for a similar level of thoroughness and clarity toward

understanding why, when, and how incumbents adapt is less satisfying. I propose that to advance this area of scholarship, we must challenge the emphasis on variance thinking and more thoroughly integrate analysis of the processes of managerial choices and the issue-specific factors affecting them when activated. While firms have varying analysis and decision-making capabilities, each adaptation decision involves unique factors and considerations.

Just as a stereoscope uses two lenses to produce crisp, three-dimensional images, the perspective I encourage involves two vantage points that, when integrated, can improve our holistic understanding of incumbent adaptation to technological discontinuities. One vantage point, a new way to consider the findings of the dominant lens, emphasizes the identification and understanding of incumbents' *capacity* to adapt. The other emphasizes the analysis of the factors influencing incumbents' *specific choices* related to adapting, i.e. if, when, and how to adapt. The former has a more static, latent nature while the latter is dynamic and issue specific. Identifying characteristics is great for theory to explain a phenomenon, but managers need to know what to do in the moment. Much greater emphasis on understanding how managers can make specific adaptation choices would be a valuable shift in this stream of research. It is my view that by integrating resource and capabilities-based views (i.e. variance approaches) with a behavioral process view we can best advance the literature to enrich both theory and practice.

In search of a holistic view...or not

For all topics in management theory, literature reviews can be valuable retrospectives and agenda-setters. The topic of incumbent adaptation to technological discontinuities is no different. Hill & Rothaermel (2003), for example, offered a multi-theoretic perspective that identified economic, organization theory, and strategic management explanations for why some incumbents are more effective than others in responding to technological discontinuities. They proposed that certain configurations of firm and technology characteristics enable incumbents to overcome the challenges and achieve superior performance. While their analysis was valuable in highlighting the multiple theoretical explanations for successful adaptation, the result is a rather unconnected set of factors such as investments in basic R&D, a real options perspective to strategizing, fostering autonomous experimentation through the organization (i.e. exploration), structural differentiation (i.e. organizational ambidexterity), possession of complementary assets, experience with change and slack resources. Hill & Rothaermel (2003) were somewhat limited in their view due to the lack of attention given in the prior literature to cognitive and decision process aspects of incumbent adaptation. Benefiting from another decade of research to build on, Ansari & Krop's (2012) review proposed a contingency viewpoint aimed at reflecting the complexity of the phenomenon. Their integrative review supported nine diverse propositions regarding how incumbent survival is affected by the interactions of a dozen different firm, technology, and environmental characteristics. Through their valuable summation of the extensive inventory of variables in this literature, what the authors describe as their "generic framework" (p. 1371), this review showcases the necessity of a contingency perspective when seeking a holistic theory. However, there is no attention in their framework related to how factors affect decisions related to if, when, and how firms adapt. Most recently, Eggers & Park (2018) turned their hands up on all of this and concluded that scholars should just recognize and accept the complexity of the phenomenon and stop striving for grand theories or silver bullet explanations. Instead, they also propose another contingency framework specifically addressing how firms overcome barriers to possessing resources necessary for adapting to different types of technological

developments. Little of this review, like those before, addresses factors affecting specific managerial choices.

Missing the middle

Studies on this phenomenon have identified quite a list of variables associated with successful adaptation to technological shifts (see [Appendix](#)). The necessity of a contingency view to relate firm, technology and contextual variables is also now well-established. What the literature lacks is adequate attention to the critical mediating process of choice. Too much of the literature, including the above integrative reviews, stakes itself to resource-based theory (RBT) to correlate characteristics of a firm in its pre-discontinuity state with its successful adaptation, with success often defined as economic outcomes many years away from the original response to the discontinuity. For example, [Rothaermel & Hill \(2005\)](#) correlated firms' pre-discontinuity financial strength and R&D capabilities with post-discontinuity performance (i.e. return on assets and return on equity). They describe these two variables "as determinants of the adaptive ability of incumbent firms" (p. 55). [Ansari & Krop \(2012\)](#), similarly connect *ex ante* variables with the distant outcome of survival and argue that firms' ambidextrous processes, cross-boundary management mechanisms, and linkages with complementary commercialization assets affect their chances of surviving a radical technological shift.

RBT is a valuable perspective for explaining competitive advantage in terms of firm characteristics. This view, however, emphasizes static, pre-existing stocks of resources and capabilities and does not speak to managerial discretion and factors influencing issue-specific choices ([Pisano, 2017](#)). Assets and capabilities do not cause strategic actions and performance outcomes. Firm characteristics merely influence and enable a firm's actions to capitalize on competitive asymmetries ([Greve, 2003](#); [Ketchen, Hult, & Slater, 2007](#)). Characteristics may correlate with desired performance, but they do not explain the path taken toward achieving that performance (i.e. the rationales for decisions addressing the *when, why* and *how* questions about adapting to a specific issue). A relatively few studies are grounded on dynamic capabilities theory ([Anand et al., 2010](#); [Bergek, Berggren, Magnusson, & Hobday, 2013](#); [Danneels, 2011](#)). These are a valuable addition to studies on static characteristics because they that emphasize that managers must do something. Possessing dynamic capabilities, however, is just another pre-existing incumbent characteristic. These do not go far, therefore, in advancing practical advice on activating those capabilities and making issue-specific choices such as which capabilities should be reconfigured and when and how to do so ([Lavie, 2006](#); [Pisano, 2017](#)). Diverging from the emphasis on resources and capabilities, a small portion of the literature uses a cognitive view to identify factors such as CEO attention ([Eggers & Kaplan, 2009](#)), firm identity ([Sarkar, Osiyevskyy, & Clegg, 2018](#); [Tripsas, 2009](#)), schemas for interpreting the value of resources ([Danneels, 2011](#)) and issue interpretation (c.f. [Mitchell, 1989](#), [Sarkar et al., 2018](#)). While effectively correlating these antecedent factors with incumbent adaptation, the cognitive-based studies do not go far to specifically address how these factors affect the choices involved in adaptation. Like the RBT studies, these works identify characteristics of firms and managers. They do not, however, directly delve into the factors affecting processes and specific choices about if, when and how to adapt.

In no way am I discounting the value of prior research. Variance studies identifying characteristics that quantitatively correlate or qualitatively associate with successful adaptation have been immensely valuable. Variables that express what a firm possesses, what they are capable of, and the nature of the issue and competitive context are limited, however, in fully explaining resulting outcomes of adaptive choices. Rather than being

directly relatable to longer-term outcomes, pre-existing conditions influence strategic choice processes that mediate the relationships between antecedents and longer-term performance outcomes. Furthermore, as a process, adaptation is not a one-time event explainable by variance analysis. Choices and firm' strategic behaviors are made, adjusted, reversed, extended, etc. Progress in this literature can be achieved, therefore, with more attention to developing what we might call a theory of adaptive choices.

Choice: a critical mediation process

Managerial choices – not resources or capabilities or contingency conditions – are the means through which a firm's resource base is activated, reconfigured and directed toward desired outcomes in response to a strategic issue (Child, 1997; Pisano, 2017). This choice perspective is emphasized in the literatures on strategic cognition (Narayanan, Zane, & Kemmerer, 2011), the behavioral theory of the firm (Argote & Greve, 2007; Cyert & March, 1963; Gavetti, Greve, Levinthal, & Ocasio, 2012), strategic issue diagnosis (Dutton & Duncan, 1987; Dutton, Fahey, & Narayanan, 1983) and decision-making (March, 1994). For example, “the behavioral theory of the firm emphasizes the organizational processes of performance evaluation, search, and decision making, and leads to propositions concerning how these affect organizational changes” (Greve, 2003, p. 686).

An emphasis on choice as behavior requires attention to issue-specific decision process factors and thus contrasts against organizational theories like the resource-based view which focus on firm-specific content factors, i.e. assets, capabilities, structures and relationships (Argote & Greve, 2007). Content and process perspectives, however, are complementary (Hutzschenreuter & Kleindienst, 2006) and critically related because choice processes are mechanisms that shape and are shaped by content and context (Greve, 2003). As a result, “predictions (of firm behavior and outcomes) without a process justification are seen as less legitimate and less theoretically satisfying than those that specify the underlying theoretical mechanisms” (Argote & Greve, 2007; p. 338). Recognizing the differences and relationship between content and process perspectives hints at an important distinction between firm-level capacity factors, addressable with a resource-based perspective, and choice factors which are described via behavioral, decision-making process perspective. That is, some factors define and characterize the pre-existing capacity of a firm to adapt. Other factors, including assessments of adaptive capacity, have bearing on specific adaptive choices. This distinction between capacity to adapt and their choices to adapt is important for progress in research on incumbent adaptation to technological discontinuities.

Distinguishing between capacity and choice

Capacity refers to a competency or capability to perform some task or to accommodate or produce some volume of output (Merriem-Webster.com). In organizational research, for example, firms with a greater level of absorptive capacity (Zahra & George, 2002) are expected to more rapidly and effectively learn about and adapt to changes in their external environment. Capacity is, in resource-based theory (RBT) language, a heterogeneous resource bundle describing the quality of a firm's competency to do something. It is a *condition or state of being*. Because it refers to behavioral or performance abilities and potential and not to specific activity or performance outcomes, capacity describes a *latent* resource that exists separate from and prior to the emergence of a specific issue it can address. Processes and routines for making choices regarding adaptation, and the dynamic capabilities necessary to identify and execute such changes comprise a feature of generalized capacity for adaptation. These routines, however, are not issue-specific. That is,

capacity is not specific to any strategic issue. Rather, it is a *generalized resource* available and potentially applicable to a relevant scope of future unknown issues.

Choice, on the other hand, emphasizes a dynamic process of information gathering and evaluation, learning, decisions and their ensuing actions, analysis of feedback, and evaluative adjustment. Although firms have choice processes (i.e. routines), choices themselves are issue specific and dynamic in the sense that they can be changed and even reversed. Within these processes, managers matter. Decision-makers' interpretations of strategic issues and the environment are both objective and subjective (Child, 1997). Choices related to adaptation to technological discontinuities are thus affected by assessments and expectations about the trajectory and effects of a technological change and about the outcomes the firm is likely to achieve via alternative courses of action (Weiss, 1994). Even within a capabilities-based theory of strategic change, choices (e.g. what types of capabilities to develop and how and when to reconfigure resources to constitute those new capabilities) are critical in enacting dynamic capabilities (Pisano, 2017).

Making strategic choices involves a multi-phase process (March, 1994). The stimulus must first be interpreted and understood. Thus, the activities involved in strategic issue diagnosis "are critically important for understanding how and when decision-makers in organizations intentionally respond to a changed environment" (Dutton & Duncan, 1987, p. 280; Dutton et al., 1983). With technological discontinuities, decision-makers must make sense of novel, undeveloped, and ambiguous issues. The process of sensemaking thus precedes choice (Weick et al., 2005). Further, multiple evaluative judgments must be made in sensemaking and strategic issue diagnosis to help decision-makers frame an issue, determine the urgency for action, assess the feasibility of their ability to effectively respond, and form expectations about the favorability of alternative responses (Dutton & Duncan, 1987; Dutton & Jackson, 1987; Weick et al., 2005). Differences across incumbents in their processes of giving meaning to an issue and the factors considered and affecting those judgments are thus root causes of different strategic choices (i.e. adaptation, timing, mode of response) among incumbents and thus their ultimate performance heterogeneity (Dutton & Jackson, 1987).

In sum, capacity and choice are related yet distinct dimensions of adaptation (Table 1). Whereas capacity to adapt is an *ex ante* state of being and an exploitable resource firms possess to some degree, choices related to adaptation derive from a process of firm behavior, i.e. the consideration and analysis of multiple factors related to a specific issue. Whereas capacity is a latent resource existing separate from and prior to a strategic issue, the determinants of choices *are relevant only when needed to address a specific issue*. Unlike capacity, choice involves a great deal of judgment and subjective interpretation about an

Variables relate to or describe	Theoretical bases
<i>Capacity</i>	
Characteristics of a specific firm	Resource-based view
A state or condition	Dynamic capabilities
A latent resource existing prior to any issue	Organizational inertia
A general resource applicable to many issues	
<i>Choice</i>	
Characteristics of a specific issue	Behavioral theory of the firm
Factors relevant only when choice processes are active	Strategic issue diagnosis
Decision-maker motives and cognitive frames	Strategic choice
A process related to a specific issue	

Table 1.
Distinguishing
characteristics and
underlying theory of
capacity and choice

issue and its context. Decision-makers must interpret an issue, anticipate its potential effects on their firm and stakeholders and evaluate the feasibility and favorability of alternative responses. In these evaluations, the whole set of firm, technology and environmental variables comes into play. This is because the response to a technological discontinuity requires decisions about if, when and how to respond. At this point, capacity is most vital when put into relative terms *vis-à-vis* rivals. An incumbent's choices are affected not just by their absolute resource stocks but by managerial assessment of those stocks relative to real and potential rivals (Haleblian, McNamara, Kolev, & Dykes, 2012; Ndofor, Sirmon, & He, 2011; Sirmon, Hitt, Arregle, & Campbell, 2010). Other competitive judgments come into play regarding urgency to respond and the choice of what type of response is most appropriate (Cozzolino & Rothaermel, 2018).

Conclusion

Incumbent adaptation to technological discontinuities is a complex whole that can only be understood through a recognition of its essential and distinctive parts. Rather than give the Greek's all the fun, let me now use a quote from the enlightenment-era Frenchman Blaise Pascal: "Since everything then is cause and effect, dependent and supporting, mediate and immediate, and all is held together by a natural though imperceptible chain, which binds together things most distant and most different, I hold it equally impossible to know the parts without knowing the whole, and to know the whole without knowing the parts in detail."

As a dominant and complex force for firm adaptation, focusing on the phenomenon of technological discontinuities can inform our theory of firm adaptation more generally. I concur with Eggers and Park (2018) that it is unreasonable to expect that one grand theory of incumbent adaptation to technological discontinuities can be developed. Neither can we expect overly narrow theories to explain anything more than indirect effects of firm characteristics on performance after a technological shift transforms an industry. What can be helpful, therefore, is to break the larger system of factors and processes into manageable subsystems, examine each critically, and reassemble the whole for interpreting greater meaning. I propose that segmenting variables based on their effect on a firm's capacity to adapt or on their effect on a firm's choices to adapt to a specific issue can help in this regard. More attention is needed on the direct, proximate determinants of what occurs in the process of adaptation, e.g. the intermediate choices to adapt, the timing of adaptive actions and the selection of a means for adapting. These if, when and how choices are critical, path-defining intermediate outcomes that influence future performance (not to mention their effects on the entirety of decisions by rivals and potential new entrants). Additional work must then associate specific choices with performance outcomes to complete both sides of the mediated cause-effect model connecting characteristics of the decision issue (i.e. firm, technology and contextual factors) with resulting performance outcomes.

Distinguishing resource-based capacity variables and behavioral-based choice variables can fuel progress in the literature on incumbent adaptation to technological changes. Such progress can likely support novel refinements and insights to advance understanding such a theory on incumbent capacity for first-mover advantage (Lieberman & Montgomery, 1988), a theory of incumbent capacity to withstand non-adaptation (Adner & Snow, 2010), a theory on incumbent choice to pursue alternatives to competitive handwagons (Abrahamson & Rosenkopf, 1993), or a theory on incumbent choice to flee a technology discontinuity. Additional implications emerge when a process perspective is emphasized to examine adaptation not as an event or outcome, but as a complex, evolving phenomenon. For example, the stage of a technological discontinuity's emergence and diffusion, and the cycle in which the incumbent is making initial or adjustment decisions, is likely to require

different aspects of capacity and different skills in making choices. Adaptation is not a one-time decision or event; as a technology evolves and knowledge of it is refined and diffused throughout an industry and market, the variables affecting choices will also evolve. This calls for longitudinal, process research (Langley, 1999) examining how factors affecting both capacity and choice coevolve as a discontinuous technology evolves and become increasingly more certain.

Distinguishing capacity and choice also has implications for managers. Capacity, for example, is a resource to be developed and exercised in anticipation of its future applications. Variation in competitive and technological conditions calls for variations in what constitutes an appropriate, and most likely valuable, competitive adaptive capacity. Research, such as that on dynamic capabilities and organizational ambidexterity, already offers advice on what variables constitute a generally appropriate capacity to adapt. More explicit framing and examination of capacity variables' effects on specific choices, however, can add more fine-grained prescriptive value for resource allocation priorities. That is, research could extend contingency perspectives to suggest which capacity factors are most valuable under distinct environmental conditions. Greater examination of factors affecting specific types of adaptation choices, on the other hand, can inform the appropriate development of search and decision-making processes and frameworks, interpretive skills, training, search and other process routines and cognitive abilities to accurately assess the competitive and adaptive value of relevant resources and capabilities. In some cases, the quality of the issue-specific managerial decision processes leading to specific adaptive choices may be far more valuable than adaptive capacity factors. Management's understanding of how individual capacity factors affect decision processes for making specific types of adaptive choices, therefore, may be the driver of superior adaptive actions. This area of research is where leadership, sensemaking, culture, training and the design and management of individual and team decision-making processes can be valuable topics. A potential outcome of such research may be choice factor (i.e. decision) frameworks applicable for specific types of change stimuli, specific if, when, and how decisions and variations of firm context.

I certainly do not propose we abandon variance studies to further identify or refine antecedent correlations with adaptive performance or to divert attention away from further research to clarify and validate contingency models. But within these continued research paths, and in pursuing valuable new approaches to develop theory and practice related to this phenomenon, I believe clarity on the distinctive natures of capacity and choice are vital for meaningfully advancing the literature. Monsieur Pascal, I hope, would have agreed that these distinctions can help scholars illuminate important mediate and immediate cause and effect relationships and the imperceptible chain that binds them together.

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Hill & Rothaermel (2003)

Representative works referenced

Economic explanations of inertia:

Incentives; risk and returns

Henderson (1993), Reinganum (1983)

Organizational explanations of inertia:

Inertia from drive toward predicatability,
stability via formalization

Hannan & Freeman (1984)

Structured routines

Levitt & March (1989), Miller (1990), Leonard-Barton (1992)

Power and politics

Pfeffer & Salancik (1978)

Macro-cultural homogeneity norms

Abrahamson & Fombrun (1994)

Strategic explanations of inertia:

Network and stakeholder embeddedness

Rosenbloom & Christensen (1994), Sull et al. (1997)

Resource dependence

Christensen (1997), Pfeffer & Salancik (1978)

Strategic commitments

Ghemawat (1991)

Ansari & Krop (2012)

Industry characteristics

Industry and value network structure

Christensen (1997), Rosenbloom & Christensen (1998), Jacobides et al. (2006)

Complementary markets

Porter (2008), Ansari & Garud (2009)

Institutional factors

Benner (2010)

Characteristics of demand/customer relationships

Adner (2002), Christensen & Bower (1996)

Characteristics of suppliers/supplier relationships

Dyer (1996)

Rivalry and turbulence

King & Tucci (2002), Eisenhardt & Martin (2000), Lazonick (1991)

Incumbent characteristics

Boundary management/boundary spanning

Network relationships/alliances/outsourcing

Kapoor & Adner (2012), Parmigiani & Mitchell (2009), Rothaermel (2001), Rosenkopf & Nerker (2001), Rothaermel & Boeker (2008)

Incumbent configuration

Cognitive models

Tripsas & Gavetti (2000)

Stakeholder commitments

Christensen & Bower (1996)

Misaligned incentives

Tripsas & Gavetti (2000)

Structure- formal and informal

Tushman & O'Reilly (1996), MacMillan & Selden (2008), Hage (1999), Smith, Collins, & Clark (2005), Burgelman (1991)

Power

Dougherty & Hardy (1996)

Complementary capabilities

Transformational experience

Lavie (2006)

Upstream/cospecialized complementary assets

Adner & Kapoor (2010), Teece (1986)

Interorganizational linkages

Taylor & Helfat (2009)

Application and commercialization capabilities

Sosa (2009)

Challenge characteristics

Characteristics of the innovation

Tushman & Anderson (1986), Tripsas (2009), Christensen (1997), Henderson & Clark (1990)

Commercialization requirements

Hill & Rothaermel (2003), Rothaermel & Hill (2005)

Incubation period

Klepper & Simons (2000), D'Aveni (2002)

Effects on value network

Bryce & Dyer (2007)

Table A1.
Summary of antecedent factors explaining incumbent adaptation to discontinuous technological change

(continued)

Eggers & Park (2018)	Representative works referenced
Firm size	Agarwal & Audretsch (2001), Banbury & Mitchell (1995), McKendrick & Wade (2010)
Firm experience	Cattani (2005), Eggers (2012), King & Tucci (2002), Klepper & Simons (2000)
Complementary assets	Helfat & Leiberman (2002), Rothaermel (2001), Rothaermel & Hill (2005), Teece (1986), Tripsas (1997)
Commitments	Benner (2009), Chandy & Tellis (1998), Christensen & Bower (1996), Sull, Tedlow, & Rosenbloom (1997)
Cognition & identity	Eggers & Kaplan (2009), Nag, Gorley, & Gioia (2007), Tripsas (2009), Tripsas & Gavetti (2000)
Top management characteristics	Gerstner et al. (2013), Maula et al. (2013)
Organizational structure	Afuah (2001), Argyres & Silverman (2004), Kapoor & Adner (2012)
Stakeholder relationships	Benner (2007), Konig et al. (2013)
Ecosystem & industry structure	Adner & Kapoor (2010), Jacobides et al. (2006)
Employee mobility	Felin (2016), Griffith & Macartney (2014)

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William Carter is an Assistant Professor of Management at the University of Baltimore. He has over two decades of experience in business including roles as a chief marketing and strategy officer, a management consultant, and a small business owner. His research interests focus on understanding the influences on and consequences of strategic choices of incumbent and entrepreneurial firms in the context of radical technological change. William Carter can be contacted at: wccarter@ubalt.edu

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