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Disruptive Innovation: An Intellectual History and Directions for Future Research

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ABSTRACT The concept of disruptive innovation has gained considerable currency among practitioners despite widespread misunderstanding of its core principles. Similarly, foundational research on disruption has elicited frequent citation and vibrant debate in academic circles, but subsequent empirical research has rarely engaged with its key theoretical arguments. This inconsistent reception warrants a thoughtful evaluation of research on disruptive innovation within management and strategy. We trace the theory's intellectual history, noting how its core principles have been clarified by anomaly-seeking research. We also trace the theory's evolution from a technology-change framework—essentially descriptive and relatively limited in scope—to a more broadly explanatory causal theory of innovation and competitive response. This assessment reveals that our understanding of the phenomenon of disruption has changed as the theory has developed. To reinvigorate academic interest in disruptive innovation, we propose several underexplored topics—response strategies, performance trajectories, and innovation metrics—to guide future research.

Keywords: competitive strategy, disruptive innovation, innovation metrics, systemic industries, technology trajectories

INTRODUCTION

The theory of disruptive innovation[1] presents some intriguing inconsistencies. The original concept has gained widespread currency among practitioners, and the term *disruption* has entered the prevailing business lexicon (Christensen et al.,

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2015). Meanwhile, however, the theory's core concepts remain widely misunderstood (Christensen, 2006; Raynor, 2011a). As an applied field, management seeks to develop prescriptive advice for practitioners (Gulati, 2007; Hambrick, 1994; Tushman and O'Reilly, 2007); disruption theory is likely to occupy a prominent position on any assessment of relevance. But despite extensive citations of the foundational work in such diverse academic fields as innovation, technology strategy, organization theory, marketing, economics, and healthcare (Di Stefano et al., 2012), and vibrant debate about the underlying theoretical concepts (Christensen, 2006; Danneels, 2004; Gans, 2016; Henderson, 2006; King and Tucci, 2002; Slater and Narver, 1998; Sood and Tellis, 2005, 2011 ; Utterback and Acee, 2005), management research that directly builds on disruptive innovation's core concepts has exhibited a surprisingly uneven trajectory.

A related issue is overuse of *disruptive innovation/disruption* as a synonym for any new threat (or substantial ongoing change) and underuse of disruptive innovation as a theoretical concept. Many popular writers invoke disruptive innovation to describe any new technology or startup that aims to shake up an industry and alter its competitive patterns; previously successful incumbents facing difficulties or going out of business are routinely said to have been disrupted (Christensen et al., 2015). Conflating disruptive innovation with any generic threat (and ignoring its more precise theoretical meaning) creates two potential risks. First, when the core ideas of prior work are obscured by indiscriminate use of its terminology, researchers will face difficulty building on and extending that work. This risk is especially pronounced in this case, given the widespread invocation of disruption-related terminology in academic journals, practitioner-oriented publications, and books in multiple disciplines. Second, practitioners who rely on incorrect or misleading renditions of disruptive-innovation theory may be tempted to apply faulty ideas, reducing their chances of success. Given the contingent nature of disruption theory, applying a one-size-fits-all solution is a particularly egregious mistake.

To address this situation and to invite renewed scholarly attention to disruptive innovation (e.g., Ansari et al., 2016), we undertake two tasks aimed at a single objective. First, we offer an updated and integrated conceptualization of disruptive innovation by drawing on studies from academic journals, practitioner outlets, and books. Our aim is to present a coherent perspective on the theory, tracing its intellectual history as it has evolved from a descriptive account of responses to technology change to a normative theory of innovation and competitive response. Here, we contribute by offering several points of clarification to a comprehensive, though scattered, literature, and by providing a unified theoretical base on which subsequent researchers can build. Second, in an effort to reinvigorate academic interest and spur exciting new research on disruptive innovation in management, we propose three novel topic areas that build on this newly unified base: response strategies, performance trajectories, and innovation metrics. These areas appear ripe for exploration; scholars who tackle them have the potential to enrich the theory of disruptive innovation and to extend its trajectory of improvement.

After outlining our research approach, we will describe the origins of the theory. Via a conceptually-focused review of the relevant literature, we will then lay out the basic tenets of disruptive innovation and trace major turning points in its evolution. Paying particular attention to how *anomalies*[2] have shaped and refined the theory over time, we point out some problems encountered in applying the theory, how they arise, and why precision matters for scholarship in this domain. Building on the newly unified theoretical base we present here, we then elaborate on the three novel topic areas and discuss their implications for research and practice.

REVIEWING RESEARCH ON DISRUPTIVE INNOVATION

Our conceptually-focused review of research relevant to the theory of disruptive innovation closely adhered to the procedures employed in other theory-focused reviews (see for example Zhao et al., 2017), progressing through three phases. In the first phase, we looked for broad patterns in references to early formulations of disruption theory by searching the Web of Science database for all academic articles citing Bower and Christensen (1995), Christensen and Bower (1996), or Christensen (1997). To pinpoint differences across academic domains over time, we distinguished between articles published in management journals and those published elsewhere, between 1993 and 2016. This procedure yielded 1,024 academic articles (513 in management) that cited the three foundational works.

In the second phase, we examined uses of disruption theory terminology. To gauge uses by scholars, we searched the Web of Science database for all academic articles in management published between 1993 and 2016 that mentioned specific disruption terminology ('disruptive technology,' 'disruptive technologies,' or 'disruptive innovation'). To gauge uses by journalists and practitioners, we searched Factiva and Lexis Nexis databases for all general-interest articles published between 1993 and 2016 mentioning any of these terms. This procedure yielded 133 academic articles in management and 66,773 articles in general-interest outlets. Our goal in these first two phases was intentionally explorative and descriptive: to better understand broad usage trends in both academic and general-interest publications.

In the third phase, we used a manual process to determine which academic works to draw on in our conceptualization of disruptive innovation. One author and two coders independently reviewed the entire set of articles identified in the first two phases to determine whether they engaged substantively with the core concepts of disruption theory; articles deemed by at least two coders to cite foundational disruption articles in a merely pro-forma way were excluded (Zhao et al., 2017). We also solicited ideas from several experts—scholars who claimed disruptive innovation as a core area of interest. They suggested relevant books and general-interest articles that would otherwise have been difficult to identify via the process just described. Given our emphasis on intellectual history (rather than a literature review per se), we relied on prior efforts to trace disruption

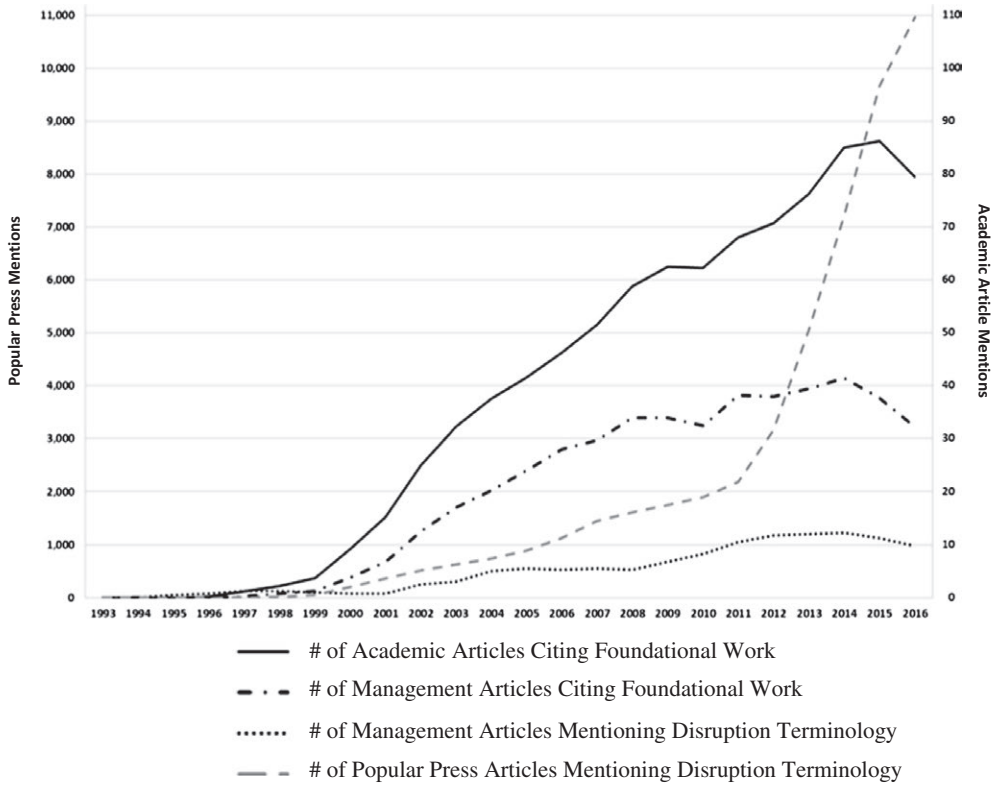

Figure 1. Scholarly and popular-press citations of disruptive innovation, 1993–2016
Note: Trend lines are calculated based on four-year moving averages of articles.

theory's development (e.g., Christensen, 2006; Christensen and Raynor, 2003), and reviewed concepts acknowledged elsewhere as having inspired disruption theory's original formulation (e.g., Pfeffer and Salancik, 1978).

Figure 1 plots the numbers of academic and general-interest articles we found, by year (the first two phases of our review). As expected, we see a steady rise in academic interest in the topic, indicated by an increase in articles citing foundational work on disruptive innovation. The management domain exhibits an initial upward trend in citations comparable to that for all academic disciplines, tapering off during the last decade. In general, the figure suggests a recent decrease in direct engagement with disruption theory arguments. Our own reading revealed frequent pro-forma references (e.g., citations in the introduction/discussion sections of a paper rather than the theory or hypothesis-development sections). In general-interest publications, the trend is different still: a relatively slow increase followed by a steep and sustained rise in use of disruption theory terminology.

These trends indicate that the concept of disruptive innovation has gained considerable currency among practitioners, and that its terminology has entered the business lexicon—good news for any management theory aiming to influence management practice. But our reading of the popular literature, in conjunction

with the trends in management research noted above, suggests overly broad application of the terms *disruption/disruptive innovation* to signify threat or change of any kind, and underuse of disruptive innovation as a coherent theoretical concept.

THEORETICAL DEVELOPMENT

Origins of a Descriptive Framework: The Disk-Drive Industry

Like other management theories, the theory of disruptive innovation began with an observation that generated a research question. Across industries ranging from computers to retail to steel, leading firms failed to remain dominant in their respective markets. These apparently well-managed firms were widely lauded by analysts and the business press, and yet each of them overlooked something important that precipitated a decline.[3] Prevailing explanations blamed technological complexity, faulty managerial cognition, and organizational inertia (Henderson, 1993; Henderson and Clark, 1990; Tushman and Anderson, 1986). But the initial observation also generated an explanatory framework and a related research program that sought to account in a different way for the struggles of leading firms in the face of certain types of market and technological change.

To investigate the drivers of this failure, Christensen (1997) first examined the disk-drive industry. The results of this multi-method study indicated that, when an innovation emerged that improved performance on dimensions that customers historically valued (e.g., the capacity and recording density of disk drives), incumbents tended to lead commercialization and to maintain their market position. However, when an innovation emerged that did not improve performance along this customer-preference trajectory but introduced a unique constellation of attributes (e.g., small, lightweight, rugged), new entrants led development while incumbents languished or failed. This pattern was observed consistently across multiple technological generations and product lifecycles (Christensen et al., 1998; Rosenbloom and Christensen, 1994).

From his study of the disk-drive industry, Christensen (1997) induced an account of disruptive innovation that consisted of three principal components. First, in many industries, the pace of technological progress outstrips customers' demand for higher-performing technologies. As a result, incumbents can *overserve* the market by producing more advanced, feature-rich products than customers need; doing so leaves a gap at the bottom of the market between customers' needs and the performance provided by firms—a gap that provides an opening for entrants (see Figure 2). Second, for firms, a strategically crucial distinction between different types of innovation—in technology or in business model[4]—can emerge in an industry. Most are *sustaining innovations*, which improve products and services along dimensions of performance that mainstream customers care about and that markets have historically valued; such innovations enable incumbents to sell more products to their best existing customers at higher margins and

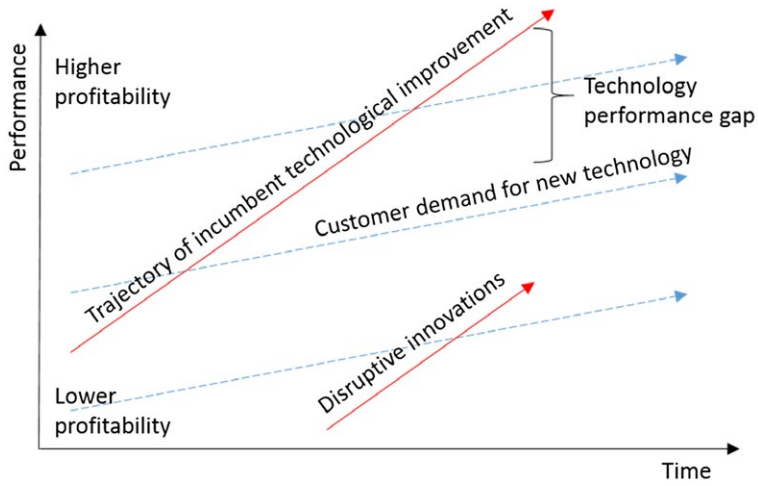

Figure 2. Model of disruptive innovation [Colour figure can be viewed at wileyonlinelibrary.com]

higher profitability. The rarer type is a *disruptive innovation*.[5] When initially introduced, disruptive innovations are *inferior* to incumbent products on accepted performance dimensions, but they offer a novel mix of attributes that appeals to fringe customer groups, notably those near the bottom of the market (see also Markman and Waldron, 2014). They may be, for instance, smaller, cheaper, more accessible, or more convenient. Finally, the third component of Christensen's model was that existing customers and established profit models constrain established firms' investments in new innovations; thus, investments unattractive to incumbents may be attractive to entrants who lack many (or any) customers and enjoy fewer competing investment opportunities. Consequently, incumbents are typically unmotivated to develop disruptive innovations that promise lower margins, target smaller markets, and introduce inferior products and services that their existing customers cannot use.

Early Pursuit of Anomalies, Extensions, and Improvements in the Model

Several subsequent studies explored whether the patterns associated with disk drives occurred in other industries. Two early case studies, of excavating equipment and steel production, were particularly noteworthy (Christensen, 1997, pp. 69–87 and 101–108). Researchers have also studied semiconductors (Christensen, 2006; d'Arbeloff, 1996), computers (Christensen, 1997), retailing (Christensen and Tedlow, 2000), motorcycles and cars (Christensen and Raynor, 2003), management education (Christensen et al., 2003), printing and newspapers (Gilbert, 2005, 2006), cardiovascular surgery (Christensen et al., 2009), management consulting (Christensen et al., 2013), cameras (Christensen, 2006), pharmaceuticals (Kapoor and Klueter, 2015), digital video recorders (Ansari et al., 2016), and financial services (Das, 2017). Numerous efforts have also been made to use the theory of disruptive innovation in practice. Among others, examples include CEO

Andy Grove's application of the theory to launch various disruptive initiatives at Intel (see Christensen, 2006) and scholar Clark Gilbert's application of the principles of disruption to turn around the Deseret News Corporation (Gilbert et al., 2012). These investigations and interventions have largely aligned with the basic tenets of disruption theory, but have also generated noteworthy elaborations.

Some arose from efforts to account for unexpected observations, or anomalies,[6] in empirical research. For instance, Christensen and Bower (1996) had initially observed that established firms did not allocate resources to disruptive innovations unappealing to their existing customers; other research showed, however, that such resources sometimes flowed freely (Lant et al., 1992). Whether incumbents exhibited core rigidities (Leonard-Barton, 1992) depended upon whether executives framed the new innovation as a threat or an opportunity. Threat framing led to greater allocation of resources to disruptive innovations; opportunity framing did not (Gilbert, 2005). But even when firms allocated resources to disruptive innovations, other inertial forces prevented them from adopting the new innovation. A second anomaly was the ability of a few incumbent leaders—despite theoretical predictions—to successfully confront disruptive innovations in their industries. For example, Gilbert's (2005) multi-case study of newspaper organizations' responses to digital media found that one newspaper maintained market leadership in the transition from print to digital. Unlike its competitors, this newspaper 'launched a structurally differentiated venture from the outset' (p. 752). Studies of semiconductors and computers, and a re-examination of disk drives, produced a similar insight: faced with disruptive innovations, leading incumbents can maintain their positions by setting up autonomous business units, separate from their parent companies, and granting them the freedom to adopt their own processes and to pursue disruptive opportunities (Gilbert, 2006; see also Gulati and Garino, 2000; and Westerman et al., 2006 for more nuanced treatments of this phenomenon).

Other surprising observations were difficult to reconcile with the original categorization scheme. Disruptive innovations were originally assumed to take root in the lowest tiers of established markets, but instances surfaced of entrants that appeared to be competing in entirely new markets. Such anomalies produced more precise categorizations of disruptions (Govindarajan and Kopalle, 2006; Markides, 2006). The initial model of disruptive innovation pinpoints *low-end disruptions*, in which upstarts enter at the bottom of the market and take hold within an existing value network before moving up-market and attacking incumbents (Christensen and Raynor, 2003). The steel industry (minimills) and retailing (discount retailers) offer examples of low-end disruptions (Christensen and Raynor, 2003; Christensen and Tedlow, 2000). By contrast, *new-market disruptions* occur in completely new value networks whose initial customers have not used the prior generation of products and services; thus, these disruptive entrants compete for customers that would otherwise go without the product or service. Because new-market disruptions compete against *non-consumption*, incumbents tend to ignore these new entrants or may not even detect them. Examples include the early PC market, Sony's transistor pocket radio, and Godrej's chotuKool,

a battery-powered portable refrigerator (Anthony et al., 2008; Charitou and Markides, 2003; Christensen and Raynor, 2003). Specifying different categories of disruption has led to a clearer conceptualization of the circumstances that give rise to disruptive innovation.[7]

Another important refinement was defining 'disruptiveness' as a *relative*, not absolute, phenomenon. In other words, a given innovation can be disruptive to one firm but sustaining to another firm. For mail-order and catalogue retailers, the internet was a sustaining innovation since they could use the internet to make more money in the way they were already structured to make money. But it was disruptive relative to in-store retailers that could not leverage the internet to improve their cost structures or business processes (Christensen and Raynor, 2003). Kapoor and Klueter's (2015) empirical investigation of pharmaceutical companies' pursuits of monoclonal antibodies and gene therapy elaborates on this point: when technological regimes do not conform to incumbents' prevailing business models (i.e., how they currently generate revenues and profits), organizational inertia results. Thus, technologies and business models go together—disruptive innovations must be evaluated relative to a firm's business model.

Such refinements pointed to a related insight: no innovation is *inherently* disruptive. Firms make strategic choices to position an innovation in a disruptive way—most often by targeting non-consumers in new markets. Experience suggests, however, that incumbents tend to 'cram' what could have otherwise been a disruptive innovation into their existing market, effectively shaping it into a sustaining innovation and neutralizing any disruptive potential (Ahlstrom, 2015; Christensen, 2006; Christensen and Raynor, 2003, pp. 114–115). For example, in the 1950's incumbents like RCA commercialized new transistor technology in their existing vacuum tube markets, while Sony deployed it disruptively—targeting a new market of non-consumers (teenagers) with their transistor radios. As transistor technology improved, Sony deployed the technology in televisions through a new value network, eventually disrupting incumbents like RCA.

Proposing Causal Mechanisms for Disruption

The original theory of disruptive innovation was a statement of correlation. Empirical findings showed that incumbents tended to outperform entrants at sustaining innovations, but underperformed at disruptive innovations (Christensen, 1997). But an intellectually convincing explanation of why this happened was lacking: no causal mechanism had been identified to link the observed association between circumstances and market-leadership outcomes.

Eventually, three separate streams of research coalesced to enable researchers to pinpoint the causal pathway. First, interviews with disk-drive managers pointed to an insidious resource-allocation process (Bower, 1970) deep within organizations that favored sustaining innovations: new-product initiatives that promised high margins by targeting large markets with identifiable customers were prioritized over disruptive innovations meant for smaller markets with less well-defined

customers—even when senior managers explicitly sought to target new disruptive markets (Burgelman, 1991, 1994, 1996). Second, resource-dependence theory held that organizations depend on resources in their external environments and that some of the most critical resources reside with customers (Pfeffer and Salancik, 1978). This precept led Christensen and Bower (1996) to posit that a 'firm's scope for strategic change is strongly bounded by the interests of external entities (customers, in this study) who provide the resources the firm needs to survive' (p. 212). In other words, because incumbents prioritize their existing customers, they value sustaining innovations over disruptive innovations; they may even ignore nascent disruptive threats that arise within separate resource networks. These two sources of insight explained incumbents' stolid response to disruptive innovations, but not why disruptive entrants eventually moved up-market to challenge incumbents, or why those incumbents in turn ceded the market rather than fighting back.

The third source of insight came from Adner and colleagues' use of mathematical models of asymmetric preferences to show that, as product performance improves, overlap between different market segments increases (Adner, 2002). Entrants pursuing low-price/high-volume strategies are motivated to invade; meanwhile, incumbents are motivated to retreat to uncontested higher tiers of the existing market (Adner and Zemsky, 2006). In short, the same mechanism—the pursuit of profitability—explains the asymmetry in motivation that prompts both types of firms to move up-market but not down-market.

Reconciling Debates, New Methodological Approaches, and Normative Theory

Vibrant debates have arisen around the theory of disruptive innovation—from the existence and prevalence of disruption (Chesbrough, 2002; King and Tucci, 2002), to the way it gets measured and assessed (Danneels, 2006), to its applicability in different industries (Christensen et al., 2009; King and Baatartogtokh, 2015). One particularly salient issue concerns whether disruption is a concept that can only be experienced after the fact. That is, does it allow for ex-ante prediction (rather than just ex-post explanation) about whether a particular innovation will eventually challenge leading incumbents (Christensen, 2006; Danneels, 2004; Markides, 2006)? Indeed, theories aim for prescriptive implications; they provide useful advice to individuals and organizations (Bazerman, 2005). To investigate these concerns, Christensen (2006) first considered predictions about an innovation's impact and presented several publicly documented cases of how companies facing disruptive threats used the model to achieve growth and market leadership. More recent examples such as Amazon's Kindle business (Stone, 2013, pp. 233–237), *The New York Times* (Benton, 2014), and Wealthfront (Rachleff, 2013) have referenced how disruption theory informed their respective innovation strategies. Second, Christensen and colleagues (2004) adopted a prospective approach, predicting ex-ante outcomes in different industries (e.g., whether newly

emerging technologies and the upstarts pursuing them would disrupt leading incumbents in that industry). Outcomes later observed were consistent with predictions in four of the six industries (see Christensen et al., 2004).

In a similar vein, Raynor (2011b) reports on several experiments conducted to test the predictive accuracy of some of the theory's core insights. One set of studies compiled data on 48 ventures launched as part of Intel's internal corporate venturing program; blind to actual outcomes, the researchers developed hypotheses intended to predict the new ventures' successes or failures. Specifically, if an innovation was sustaining and Intel was an incumbent in the target market, the venture would succeed (fail); if the innovation was disruptive and an autonomous business unit was formed to pursue it, the venture would succeed (fail). Leveraging business plans to classify the ventures and survival (demise) to proxy performance, the theory had a statistically significant impact on correctly predicting the outcomes of the businesses (Raynor, 2011a).

A second set of studies used a training intervention to examine the impact of exposure to disruption theory on the ability of graduate business students at three universities to correctly predict the outcomes of innovative ventures (Raynor, 2011b; see Burt and Ronchi, 2007 for a similar research design on social capital). Subjects received a set of six disguised business plans (plans were randomly selected from the 48 new business ventures mentioned above), and were asked to predict which would survive and which would fail. As a population, these students' results were no different than the actual survival rate of the portfolio of 48 new business ventures (about 10%). After being provided with basic instruction on disruption theory, the students were randomly assigned six more cases. Results indicated a statistically significant increase in the students' ability to predict successes and failures. There are limitations to the study's design, namely its small sample size and its coarse proxy for the outcomes of disruption (firm success/failure rather than market leadership), and more work is clearly needed in this area. But together with other empirical evidence and the specification of a causal mechanism, these studies provide intriguing insight for a normative theory of disruptive innovation (See Table I for selected studies that emerged during the third phase of our conceptual review. We highlight illustrative studies that formulated, built upon, challenged, or refined disruption theory or that inspired its development).

DIRECTIONS FOR FUTURE RESEARCH ON DISRUPTIVE INNOVATION

A fundamental premise of our assessment thus far is that researchers' understanding of the phenomenon of disruption has evolved over time as the process of anomaly-seeking research has extended and refined the theory. Cumulative effort has produced a rich and useful theory, but many opportunities for further research remain unexplored. Building on the unified theoretical base that emerged from our review, we have identified three novel topic areas that promise to enrich and extend disruptive innovation theory—response strategies, performance trajectories, and innovation metrics. Throughout our discussion of these

Table I. Selected studies related to disruptive innovation theory, 1970–2016

Study	Key findings	Relevance to disruptive innovation theory
Bower (1970)	Strategic investment decisions in innovations are the result of a firm's internal resource allocation processes. Innovation ideas are filtered by middle managers who decide to give 'impetus' to certain ideas by raising them to the level of top management while deciding to not pursue others.	Foundational to disruption theory. Disruption theory builds on Bower by showing how the impetus given to different types of technology development programs are determined by the firm's market position rather than the nature or extent of technological change, arguing that this accounts for differences in firms' technological innovation success.
Pfeffer and Salancik (1978)	Introduced the resource-dependent view of the firm, which is that the elements in the environment providing the resources an organization needs to survive – such as capital markets, customers, donors, and labor markets – are the ultimate determinants of what an organization can do and will be.	Foundational to disruption theory. Disruption theory extended this work by showing that customers are a key element external to firms that limit a firm's scope for strategic change.
Dosi (1982)	Continuous technological change is the product of technological advances along a defined trajectory of improvement. Discontinuous technological change, on the other hand, is associated with the emergence of a new paradigm. These new paradigms stem from the interplay between scientific advances, economic factors, and institutional variables.	Foundational to disruption theory. Disruption theory shows how a firm's trajectory of technological improvement may outstrip consumers' ability to absorb it ('overshoot'), exposing them to the threat of new entrants at lower tiers of the market.
Foster (1986)	Observed that technologies generally follow an S-Curve where early technological improvements are difficult to make, then become easier, before eventually plateauing. Argues that there is an 'attacker's advantage' in bringing new technologies to market, and that incumbents must act to offset.	Disruption theory reframes and expands upon Foster's concept of multiple S-Curves in a given market, for example by contrasting the trajectories of improvement pursued by incumbents and entrants, identifying the phenomenon of 'overshoot' by incumbent firms, and noting the asymmetry of motivation exhibited by entrants and incumbents.

(*Continued*)

Table 1. (Continued)

Study	Key findings	Relevance to disruptive innovation theory
Tushman and Anderson (1986)	Technology-based industries experience periods of incremental change punctuated by technological breakthroughs that either enhance or destroy firms' competence.	Provided inspiration for disruption theory. Poses an alternative explanation for what causes successful firms to stumble.
Henderson and Clark (1990)	Architectural innovation—change in the way product components are integrated into a system—destroys the usefulness of established firms' architectural knowledge, which is embedded in their organizational procedures.	Provided inspiration for disruption theory. Poses an alternative explanation for what causes successful firms to stumble.
Burgelman (1994)	The internal selection environment mediates the coevolution of industry-level sources of competitive advantage and firm-level sources of distinctive competence and into the link between corporate strategy and strategic action.	Demonstrates how the resource-allocation process favors initiatives that promise large markets with identifiable customers and high margins over innovations meant for smaller markets with less-well-defined customers.
Rosenbloom and Christensen (1994)	Entrants find greatest advantage when innovations disrupt established trajectories of technological progress, a circumstance associated with moves to new value networks. The incumbent's disadvantage, hence, seems to be associated with an inability to change strategies, not technologies.	Introduces several of the core concepts of disruption theory.
Christensen and Bower (1996)	Innovation success is not merely driven by technological competence but also by the strategic investment decisions within firms– decisions collectively called 'the resource allocation process'. Shows how this process can systematically deny resources to emerging technologies whose initial performance characteristics make them competitive only in emerging market segments, focusing resources instead on innovations whose performance attributes are favored by current customers.	Explains the process whereby firms are driven upmarket, eventually 'overshooting' the needs of the majority of their customers and creating a vacuum for disruptive entrants to fill.

Garud and Ahlstrom (1997)	The assessment of technology within a firm is a socio-cognitive process wherein the selection criteria for a technology eventually becomes the basis for the construction of a new reality. This new reality circumscribes what firms can see and renders them blind to other possibilities.	Introduces a finer mechanism to explain how incumbent firms overlook or underestimate the value of disruptive innovations.
Christensen et al. (1998)	New entrants' probability of failure decreases if they are relatively large, adopt dominant design, enter during a 'window of opportunity,' and target a new market segment.	Tightens the link between new entrants and the emergence of dominant designs.
Slater and Narver (1998)	Argues that there are two forms of 'customer orientation': first, a short-term focus on satisfying customers' expressed needs; second, a long-term focus on understanding and satisfying customers' latent needs. Posits that the second orientation is sound regardless of the market conditions a business faces.	Questions Christensen and Bower's (1996) study of how customer power contributes to the failure of leading firms during a period of industry discontinuity.
Christensen and Tedlow (2000)	Identifies recurring patterns of disruption within the retailing industry.	Provides empirical support for patterns Christensen (1997) observed in the disk drive and steel industry.
Adner (2002)	Identifies the demand conditions that enable disruptive dynamics through a formal model. Demonstrates that as product performance improves, overlap between different market segments increases.	Identifies the pursuit of profitability as the casual mechanism behind disruption.
King and Tucci (2002)	Static experience (production and sales experience) encourages market entry, but transformational experience (prior transition experience) does not.	Advances an alternative interpretation of Christensen and Bower's (1996) analysis of the disk drive industry.
Charitou and Markides (2003)	Disruptive strategic innovations are not necessarily superior to the traditional ways of competing, nor are they always destined to conquer the market. Rushing to embrace them can be detrimental for established companies when other responses make more sense.	Contributes to the discussion of potential response strategies that incumbents can pursue.

(*Continued*)

Table 1. (Continued)

Study	Key findings	Relevance to disruptive innovation theory
Christensen and Raynor (2003)	Introduced concept of new-market disruptions. Expanded term from 'disruptive technologies' to 'disruptive innovations' in order to account for business model innovations.	Refines the definition of disruptive innovation and provides a more thorough examination of response strategies incumbents can pursue in the face of disruptive threats.
Gilbert (2003)	In every industry changed by disruption, the net effect has been total market growth; disruption can be an avenue to growth via new-market discovery for incumbents as well as upstarts.	Explores the role of structural separation and outsider influence.
Nair and Ahlstrom (2003)	Posit that the complexity of the underlying technology, and ecological and institutional dynamics, may extend the coexistence of competing technology regimes.	Identifies additional factors that affect the rate at which disruption occurs.
Christensen et al. (2004)	Used the theory of disruptive innovation to correctly predict four out of six industries studied. Introduces a model that helps decision-makers spot the signals of industry change, determine the outcome of competitive battles, and assess whether a firm's actions will ensure or threaten future success.	Advances evidence that disruption theory can be used to make ex-ante predictions about industry change and competitive dynamics.
Danneels (2004)	Challenges the definition of disruptive technology, the predictive use of the theory of disruption, and the merits of creating a spin-off to commercialize the disruptive technology.	Calls for more debate and research around disruptive innovation.
Adner and Zemsky (2006)	Introduce a formal model of how disruptive technologies displace established technologies in mainstream segments.	Shows how changes in the structure of consumer demand and technological change drive the process of disruption.
Gilbert (2005)	A strong perception of threat helps overcome resource rigidity (failure to change resource investment patterns) but simultaneously amplifies routine rigidity (failure to change organizational processes that use those resources).	Modifies claims Christensen and Bower (1996) made by showing that threat perception can lead to intense resource commitment, even in the absence of core customer demand.

Hüsig et al. (2005)	Practitioners should learn methods to make ex-ante distinctions between disruptive technologies and other phenomena caused by emerging technologies. Contrary to widespread assumptions, W-LAN is not likely to represent a disruptive technology.	Proposes a methodology of guided interviews that can be used to assess whether technologies are disruptive or not.
Sood and Tellis (2005)	Technology evolution follows a step function not an S-curve. The performance curves of competing technologies rarely have a single crossing, and new technologies arise as often from new entrants as from incumbents.	Seeks to problematize performance trajectories as presented in the traditional disruption model.
Christensen (2006)	Introduces a model of theory building driven by anomalies that help refine the theory. Applies this model to the theory of disruptive innovation to show how it has evolved over time.	Advances evidence for disruption theory's ability to make ex-ante predictions about innovation outcomes.
Gilbert (2006)	Opportunities associated with discontinuous change typically do not trigger organizational responses until the opportunity is perceived as a threat.	Provides contingencies about how senior managers frame disruption in developing a response strategy.
Govindarajan and Kopalle (2006)	Argues that a general measure of disruptiveness is achievable and ex-ante predictions about disruption can be made using ex-post observations.	Proposes a measure of disruptiveness for future research and addresses several of Danneel's (2004) criticisms of disruption theory.
Henderson (2006)	Explores the role of embedded organizational competencies in shaping the innovator's dilemma.	Provides a competence-based explanation in addition to Christensen's (1997) cognitive and political explanations for incumbent failure.
Markides (2006)	Argues that a disruptive technological innovation is a fundamentally different phenomenon from a disruptive business-model innovation or a disruptive product innovation; that these innovations arise in different ways, have different competitive effects, and require different responses.	Proposes refinements to the definition of the term 'disruptive innovation'.

(*Continued*)

Table I. (Continued)

Study	Key findings	Relevance to disruptive innovation theory
Rao et al. (2006)	Two or more disruptive technologies introduced in concert can result in a new discontinuous innovation that can create new forms of market value. The resulting innovation can require shifting to a different technological learning curve, and can enhance or redefine performance metrics.	Opens up questions about the interplay between multiple disruptive technologies, especially when being launched by the same firm.
Burgelman and Grove (2007)	The paper calls attention to the importance of inter-industry strategic entrepreneurial action, which the authors term 'cross-boundary disruption'.	Introduces a new concept related to 'new market disruption' that holds implications for industry-spanning innovations.
Garud and Munir (2008)	Pursuit of radical innovations may not produce the most efficient outcomes due to transformation costs associated with reconfiguring the production network around a design.	Shows how firms in systemic industries can inadvertently dismantle their unique value network when trying to introduce a disruptive innovation.
O'Reilly and Tushman (2008)	Shows how ambidexterity (the ability of a firm to simultaneously explore and exploit) is a dynamic capability that can enable a firm to adapt and survive over time.	Offers an alternative to Christensen and Raynor's (2003) recommended response for incumbents to disruption (launching a separate business unit).
Lucas and Goh (2009)	Kodak's complacent middle managers, conformist culture, and rigid, bureaucratic structure hindered a nimble response to a new technology that dramatically changed the processes of capturing and sharing images.	Adds nuance to the factors that influence the 'impetus' an innovation project receives via the resource allocation process of a firm.
Ahlstrom (2010)	Argues that the main goal of business is to develop innovations that generate economic growth and other societal benefits.	Argues that disruptive innovations can play a unique role in spurring economic development by making products and services more affordable and accessible.
Sood and Tellis (2011)	Reports that potentially disruptive technologies are introduced as frequently by incumbents as by entrants, are not cheaper than old technologies, and rarely disrupt firms. When the price is lower than that of the prevailing technology, however, they are more likely to be disruptive.	Provides evidence against the notion of 'high-end disruption'.

Raynor (2011a)	After a training intervention where MBA students were taught the basics of disruption theory, their ability to predict firm success increased by 50%.	Seeks to provide support for the claim that disruption theory can predict innovation outcomes ex ante.
Raynor (2011b)	Reports on tests of disruption theory's predictive and explanatory power and provides practical guidance for applying the theory to innovation efforts.	Seeks to make disruption theory more widely usable.
Gilbert et al. (2012)	Firms seeking to transform themselves in the face of disruption should reposition the core business to account for new market conditions and then create a separate, disruptive business unit that will become the future growth of the firm.	Develops practical guidance for confronting disruptive change, examining the real-world context of a newspaper being disrupted by digital media.
Bergek et al. (2013)	Intense competition follows in the wake of technological discontinuities. 'Creative accumulation' is a way of conceptualizing the innovative capacity of incumbents that appear to master such turbulence.	Questions the prevalence of disruption, but defines disruption by firm exit and industry destruction rather than loss of industry leadership.
Markman and Waldron (2014)	Show that market penetration is more likely when micro entrants either solidify large incumbents' positions or target small niches that are inconsequential for large incumbents.	Provides support for the asymmetry of motivation between entrants and incumbents at the heart of disruption theory.
Marx et al. (2014)	Commercialization of disruptive technologies begins as competition with incumbents, followed by a switch to cooperation. When a startup's innovation involves a potentially disruptive technology, incumbents may be wary of cooperative commercialization.	Identifies circumstances in which entrants must cooperate with incumbents in order to succeed.
McElheran (2015)	Finds that market leaders are significantly more likely to embrace new information technology-enabled practices, except when customer adjustment costs were a significant concern.	Provides support for the crucial role customers play in shaping firm innovation strategy.

(*Continued*)

Table I. (Continued)

Study	Key findings	Relevance to disruptive innovation theory
Kapoor and Klueter (2015)	Find that R&D investments in radical technological regimes often do not lead to subsequent product development because they do not confirm to the firm's prevailing business model (i.e. how the firm makes money).	Provides nuance to the idea of disruptive business model and identifies a new form of incumbent inertia—namely, the allocation of resources towards upstream invention but rigidity with respect to downstream commercialization. Shows how structural separation and outsider influence through alliances and acquisitions of start-ups can help incumbents mitigate these inertial pressures.
Kim and Min (2015)	Examines business-model innovation. Incumbents should manage conflicting assets by setting up an autonomous business unit for a new business model.	Elaborates on the incumbent response strategy of setting up an autonomous business unit.
King and Baatartogtokh (2015)	Based on surveys and interviews of experts about 77 cases discussed in Christensen's work, the authors argue that many of the theory's exemplary cases do not fit its conditions and predictions. The authors argue that disruption theory should be just one perspective managers use to understand the world around them.	Seeks to conduct an empirical test of disruption theory's conditions and predictions. Highlights the need to define the boundary conditions of disruption theory.
Zuckerman (2015)	In response to King and Baatartogtokh (2015), considers what question the theory of disruptive innovation addresses, whether it improves upon other answers to the questions it addresses, and what is core to the theory.	Suggests that the concept of 'overshoot' is actually not core to the theory of disruptive innovation and that relaxing that condition may help explain high-end encroachment patterns. Argues that the theory continues to provide valuable insight into incumbent vulnerability.

Adner and Kapoor (2016)	Understanding the pace of technological substitution requires joint consideration of the evolution of both the new and the old technologies. And that understanding this evolution requires an examination of the interdependencies in the broader ecosystem of components and complements in which the focal technologies are embedded.	Advances an explanation for why disruption occurs rapidly in some industries but slowly in others.
Ansari et al. (2016)	Firms that introduce disruptive innovations into multi-sided ecosystems confront the disruptor's dilemma: gaining the support of the incumbents they disrupt. Disruptions affect the entire ecosystem, not just specific incumbents.	Considers implications for disruption in systemic industries.
Gans (2016)	Posits that there are two kinds of disruption: demand-side (when successful firms focus on their main customers and underestimate market entrants with innovations that target niche demands); and supply-side (when firms focused on developing existing competencies become incapable of developing new ones). These different types of disruption demand different strategies.	Seeks to capture the essence of disruption theory while proposing a new framework for understanding disruption theory relative to other academic work.
O'Reilly and Tushman (2016)	Argue that incumbents can use organizational ambidexterity (enacting dual structures, processes, and subcultures, as well as a cognitively flexible team) to manage conflicts expected to arise from pursuing different types of innovations simultaneously. According to this perspective, exploring (via an emerging business) and exploiting (via an existing business), in parallel, may even help resolve the innovator's dilemma.	Advances a response strategy for incumbents facing disruptive threats.

areas, we touch on considerations for systemic or network-based industries such as those with platform businesses.

Responding to Disruptive Innovation: Identifying Strategies and Exploring Hybrids

Documenting alternative response strategies. Much empirical work has documented how the process of disruption unfolds in different industries (Christensen, 1997; Gilbert, 2003; Rosenbloom and Christensen, 1994). New entrants threaten and, in some cases, eventually overtake leading incumbents despite the latters' apparently unassailable advantages of resources, brand recognition, and market power. Meanwhile, theoretical work has specified as culprits the organizational and managerial mechanisms that contribute to disruption, notably a natural-but-ultimately-pathological devotion to an existing customer base and a sensible-but-detrimental abandonment of certain market segments (Christensen and Raynor, 2003; Christensen et al., 2008). Though productive, this focus on documenting the phenomenon and hypothesizing about its mechanisms may suggest that disruptive innovation theory is adept at framing problems (when and why disruption occurs) but mostly empty-handed when it comes to proposing solutions (what incumbents can or should do about it) (but see Anthony et al., 2008, and O'Reilly and Tushman, 2016). Indeed, according to a widely circulated anecdote dating to 1997, then-CEO of Intel Andy Grove actively sought, to no avail, explicit guidance about how his company should fend off an impending disruptive innovation (MacFarquhar, 2012; Mack and Summers, 1999).

How do (should) firms respond to disruption, and which strategies are effective? Early theoretical formulations were decidedly pessimistic, suggesting that incumbents typically ignore or retreat from disruptive encroachments.[8] But observation of a small number of established firms that maintained market leadership when facing disruption led subsequent researchers to propose what has arguably become canonical: when a disruptive innovation emerges in an adjacent market, an incumbent can create an autonomous organizational unit and task it with developing and commercializing the new innovation (Christensen, 1997). This unit, unencumbered by existing customers' insatiable demand for better-performing products, and by the margins and market-size thresholds with which established firms evaluate new business opportunities, essentially becomes an upstart—freely pursuing the disruptive opportunity in the context of a new value network. Though its primacy has been challenged (O'Reilly and Tushman, 2016), and contingencies about how senior managers frame disruption internally have been noted (Gilbert, 2005), this response strategy has enjoyed broad empirical support (Christensen and Raynor, 2003, p. 35; Gilbert, 2006).

However, incumbents can and do respond in other ways; scholars have identified several additional strategies for dealing with disruption. First, technology strategists who situate their work in the economics of transitions have shown that incumbents may aggressively invest in existing capabilities to *extend current*

performance-improvement trajectories in order to slow or delay the onset of disruption (Adner and Kapoor, 2016; Chen et al., 2010; Utterback, 1994); they may also boldly retreat by *proactively repositioning* in profitable new niches (Adner and Snow, 2010). Second, organizational theorists have argued that incumbents can use *organizational ambidexterity* (enacting dual structures, processes, and subcultures, as well as a cognitively flexible executive team) to manage conflicts expected to arise from pursuing different types of innovations simultaneously (O'Reilly and Tushman, 2016). According to this perspective, exploring (via an emerging business) and exploiting (via an existing business), in parallel, may even help resolve the innovator's dilemma (O'Reilly and Tushman, 2008, 2016). Third, scholars of entrepreneurship and innovation have shown that incumbents may seek to co-opt disruptive entrants once they start challenging incumbents' market leadership. They may do this by partnering with or licensing startups' technology once it reaches a certain threshold (Marx et al., 2014), by acquiring entrants outright (Christensen et al., 2011; Kapoor and Klueter, 2015; McDonald and Eisenhardt, 2017; Sandström et al., 2009), or (in the case of systemic network-based industries) by introducing a new platform (Altman and Tushman, 2017; Eisenmann et al., 2006; Garud and Kumaraswamy, 1995). Finally, incumbents that have been disrupted can pursue a *technology reemergence* strategy by redefining the meanings and values associated with their legacy technology, as well as by redefining the boundaries of the market they compete in (Raffaelli, 2018). By effectively creating a new dimension of performance, this strategy can enable incumbents to re-attract customers who once defected to the disruptive innovation.[9]

Collectively, this work on response strategies has enriched existing discourse by pointing out an array of potential incumbent reactions beyond the canonical. Scholars can profitably build on this promising work by conducting careful empirical analyses that links the features of these strategies to market outcomes and compares the various strategies' effectiveness. A circumstance-contingent theory of incumbent response would, we suspect, contribute substantially to disruptive innovation theory and inform strategies designed to protect against upstart competitors that are on a disruptive path.

Hybrid responses: Sustaining innovation or a path through disruption?. Scholars have recently reintroduced the notion of *hybrid offerings*, arguing for their utility as a device for managing certain types of market and technology transitions. As the term connotes, hybrid offerings combine features of an emerging innovation (either a technology or a business model) with existing offerings to create something novel (e.g., a new product)—thus introducing an interim step between competing generations (Furr and Snow, 2015b). Prominent contemporary examples include hybrid cars (which combine electric propulsion systems with conventional internal-combustion engines) and online newspapers (which merge digital technologies and business models with traditional print media). Prior research views hybrid offerings skeptically. For example, studies of technological change in a variety of industries have characterized incumbents' awkward and

unsuccessful attempts to introduce hybrid products as misguided efforts to navigate technology transitions (Foster, 1986; Tripsas, 1997). In an early case study of the mechanical-excavator industry, for example, Christensen (1997) observed that Bucyrus Erie (and similar incumbents) responded to the advent of hydraulic excavating technology by developing a hybrid product that combined conventional cable and hydraulic elements. Bucyrus Erie's product, targeted at existing customers, was plagued by limited capacity and reach and never achieved commercial viability. Along with the entire population of cable shovel makers, the company was eventually disrupted by hydraulics upstarts (pp. 69–80). Viewed in this light, hybrid offerings are the embodiments of mismanaged technology adaptation, along with such notoriously inelegant responses to disruption as Blockbuster's hybrid brick-and-mortar/online rental offering to combat Netflix.

Studies that investigate hybrid products more explicitly have challenged this dismissive assessment. Hybrids, scholars argue, can be a useful tool for learning about an uncertain future and bridging market transitions (see, for example, Ansari and Garud's (2009) discussion of hybrid 2.5G mobile networks). Studying the carburetor-to-electronic-fuel-injection-system transition in the U.S. auto industry, for example, Furr and Snow (2015a) showed that intergenerational hybrids *helped* incumbents maintain market leadership over competitors in the new technology. Under certain circumstances, they conclude, hybrid offerings constitute an effective response strategy: recombinations serve as 'stepping stones' that allow incumbents to improve their existing technology while learning and adapting to an uncertain new technology (p. 1047).

How can we reconcile these opposing views? More specifically, when might we expect hybrid offerings to enable a successful response to disruption versus creating a stumbling block for incumbents? Revisiting key concepts from disruption theory may help resolve these tensions. Consider a case study of disruptive innovation, which is a classic illustration of hybrids too. When steam power emerged, steam-powered ships underperformed conventional sailing-ship technology on nearly every dimension (notably operating costs, speed, and reliability); transoceanic shippers—the customers of sailing-ship manufacturers—could not use steam (Christensen, 1997, p. 85). Incumbent sailing ship manufacturers incorporated the new technology by introducing hybrid ocean transports (sailing ships that integrated steam power) to improve near-port navigation. Meanwhile, steam technology *did* appeal to a different market and application—inland waterways, such as rivers and lakes, where motion in the absence of wind was highly valued (Christensen, 1997, p. 86). Left to their own devices, steamship builders honed the new technology for years before eventually disrupting sailing technology in transoceanic shipping.[10] Sailing ships struggled to survive the industry's transition to steam power (Foster, 1986).

Along with mechanical excavators, the steamship case offers important insights into hybrids in the context of disruptive change and reveals promising avenues of research. First, incumbents like Bucyrus Erie have the option of developing hybrid products to target new customers and applications, but may—for the reasons outlined earlier—tend to deploy them as sustaining innovations

in performance-enhancing applications for existing customers. Future research could explore when and how incumbents overcome these tendencies. Second, upstarts like steam/sail inland-waterway transporters may develop technology hybrids as a market-entry strategy, backing up still-unreliable disruptive technologies with more trustworthy conventional technology. Future research could determine the circumstances in which a hybrid-entry strategy is preferable to a purely disruptive entry strategy. Third, though innovation research has acknowledged that hybrid offerings may combine elements of different business models (Battilana and Lee, 2014), it has largely focused on technology hybrids. Given the increasingly prominent position occupied by business models in disruption theory (Kapoor and Klueter, 2015), future research could explore the role of *business model hybrids* in incumbents' response to upstarts that are following a disruptive path (Altman and Tripsas, 2015; Battilana and Dorado, 2010).

Performance Trajectories: Exploring Variation in the Disruption Process

Another avenue for future research pertains to where and how rapidly disruption occurs. Disruption theory posits that two different performance trajectories coexist in most markets despite changing customer demands over time. One trajectory captures the rate of product improvement that customers can utilize or absorb; the other captures the rate of improvement that innovating companies provide as they strive to develop better products and services to sell to these customers. In many markets, innovators' performance improvement *exceeds* the rate of improvement that customers can absorb, a phenomenon sometimes called *overshooting the market* (Christensen, 1997).[11] In other words, a product or service that was initially not good enough for what customers needed eventually offers *more* capability than customers can actually use. At this point in time and competitive space—the intersection of the two performance trajectories—disruption occurs.

The original disruptive innovation diagrams (Figure 2) presented similarly-sloped performance trajectories, but some scholars have suggested that the rate of improvement varies quite significantly by industry (Christensen et al., 2015). For example, in the disk drive industry—what Christensen (1997) referred to as the 'fruit fly' of the business world—technology improved quickly, producing a steep performance trajectory. Disruption played out rapidly: new entrants challenged and displaced incumbents every few years. In industries like steel and discount retailing, whose performance trajectories exhibit more gradual slopes, the process of disruption unfolded over several decades (Christensen and Raynor, 2003). In still other industries, trajectories of improvement seem to almost be flat and disruption does not seem to occur at all (see Figure 3). For example, scholars have noted that low-end entrants in the hotel industry have historically struggled to move up-market to challenge high-end chains like the Four Seasons (Raynor, 2011a, p. 90). This reconceptualization of classic disruption theory suggests that disruption does not happen everywhere, nor does it play out at the same pace across industries.

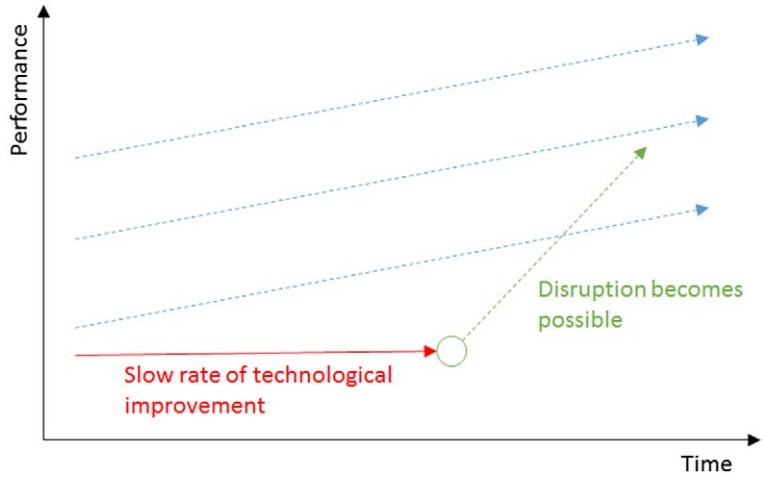

Figure 3. Kinks in improvement trajectories [Colour figure can be viewed at wileyonlinelibrary.com]

Indeed, Adner and Kapoor (2016) demonstrate how the pace of technological substitution is shaped by the evolution of both the new and the old technologies, as well as the evolution of the ecosystems in which they are each embedded. For example, some firms slow the pace of substitution through 'last gasp' efforts to extend the value they can capture from the old technology. Other substitutions are slowed because the old technology benefits from 'spillovers' of R&D efforts for the new technology—for example, an improved lens for a new lithograph in their study was also used in the old lithograph applications, extending the performance of the conventional technology. These findings suggest that trajectories of improvement and rates of substitution are not stochastic but rather are shaped by factors such as the rate of improvement of an enabling technology, decisions of incumbents and entrants, and characteristics of the ecosystems in which they operate. Collectively, observations about variance in the speed of disruption *across industries* and *within the same industry over time* lend greater specificity to the mechanism of disruption and help establish its boundary conditions.

Other scholars have identified abrupt developments that alter industry-wide trajectories of performance improvement (Christensen and Sundahl, 2016). Innovators may introduce novel technologies or business models, including those with network-centric components (Gnyawali and Madhavan, 2001; Pahnke et al., 2015), that bend the trajectory upward, steepening an existing slope, or that replace a historically flat performance-improvement path with an entirely new one. Some have referred to this as the introduction of an 'extendable core'—a business model or underlying technology that enables new entrants to move up-market and pursue more demanding customers without adding commensurate costs or otherwise losing their performance advantage (Raynor, 2011a; Wessel and Christensen, 2012). For example, the hotel industry historically resisted disruption because no such core existed that could break the tradeoffs that defined the frontier of the

incumbents' business models (Raynor, 2011a, p. 93).[12] However, temporary-lodging startup Airbnb has arguably introduced one through its unique business model, online matchmaking platform, and effective review/rating system (Hagiu and Wright, 2015; Parker et al., 2016). This has enabled Airbnb to go from appealing to a fringe segment (customers who could not afford a hotel and considered a stranger's spare room better than nothing at all) to appealing to ever-more-sophisticated customers without losing its performance advantage relative to traditional hotels.

This more nuanced perspective on performance trajectories suggests several promising avenues for future research. First, via careful empirical study, researchers could further explore the theory's boundary conditions to pin down the circumstances in which disruption is most and least likely to occur, and at what pace. Doing so would probably call for identifying the underexplored factors that make certain industries particularly vulnerable to disruption and render others disruption-proof. Second, given that disruption presupposes a unique constellation of product or service attributes, and entrants' corresponding up-market migration, what unique challenges exist for disruption in markets characterized by few differentiation opportunities (e.g., commodity and raw-materials markets) or by rigid status hierarchies and low turnover at the top (e.g., venture capital and higher education) (Bermiss et al., 2017)? Third, researchers have only tentatively specified the kinds of technologies and business models that spur dramatic change in performance trajectories in existing markets (Raynor, 2011a; Wessel and Christensen, 2012). Here, systemic industries in which network-centric businesses are emerging may provide insight on where performance trajectories change substantially (Garud and Kumaraswamy, 1995). Future empirical work can go further, specifying the nature and influence of such 'extendable cores' concretely.

Metrics as Enablers of Disruption

A third avenue for future research pertains to the metrics used to assess innovation opportunities. In early work, disruptive innovation was framed as a technology problem for incumbents. Indeed, the subtitle of *The Innovator's Dilemma's* first edition was 'When new technologies cause great firms to fail'. Scholars observed that disruptive innovations seemed, in Christensen's words, to 'promise lower profit margins per unit sold and could not be used by [an incumbent's] best customers' (Christensen, 1997). But there was little systematic investigation as to why. Subsequent empirical research and anecdotal evidence prompted a reformulation centered less on incumbents' inability to adapt to new technologies than on the challenges that innovations posed for incumbents' business models (in Christensen, 2006, p. 49, see Andy Grove's account of DEC's inability to prioritize PCs due to their lower margins and prices and despite its engineers' technical prowess in PC design). Relabeling the phenomenon *disruptive innovation*, Christensen (2006) asserted that it was the business model within which technology is deployed that paralyzes incumbent leaders: 'In other words, [disruption] was not a technology problem; it was a business model problem' (p. 43).

Consistent with these revisions, business models, especially incumbent firms' profit formulas, may constitute an underappreciated driver of disruption (Kapoor and Klueter, 2015). A sustaining product, service, or technological innovation that helps a firm make more money in the same way it is already structured to make money—and, importantly, in a way that drives up the *metrics* that stakeholders rely on to gauge success—attracts capital to the business. This scenario has two potential effects. First, it systematically drives firms up-market, since well-run companies may find it difficult to prioritize down-market investments in lower-value projects. Second, firms may simply overlook opportunities that do not jibe with the way they currently make money. Executives, rewarded for returns that occur during their tenure, tend to prioritize projects whose returns are realized quickly (Dechow and Sloan, 1991). Counterintuitively, as they pursue profitability, incumbents may become highly susceptible to disruption by startup entrants who are still developing their business models (or profit formulas) and rely on metrics different than the incumbents' metrics to gauge their success (Christensen et al., 2008).

Consider a firm seeking to increase gross margin percentage (a metric commonly used by analysts to evaluate firms across industries). It may sensibly drop low-end products from its product line and reorient toward higher-margin offerings. If instead the firm focused on improving, say, net dollars per unit sold (a less common metric), it might take different actions. Had integrated steel mills measured success by net profit per ton of steel—expressed in whole numbers rather than a ratio—they might have tried to maintain their position in rebar (whose greater volume spreads out more of the overhead costs) rather than ceding that market to minimills (Christensen and Raynor, 2003).

Technology assessment perspectives characterize technology evaluation not as an 'objective' process but as one that is shaped and circumscribed via socio-cognitive processes (see Garud and Ahlstrom, 1997). The notion that different assessment routines can set direction is consistent with the idea that managers employing particular financial metrics and tools that are popular today may unwittingly create a bias against certain types of innovation, sowing the seeds of disruption (Christensen et al., 2008). First, they may fail to consider some of the unintended consequences of marginal- and sunk-cost thinking. Adhering to the tenets of financial accounting may lead incumbents to retain and leverage old technology because its marginal costs are low, whereas new technologies often entail large up-front costs that temporarily use up cash or dilute equity. (Here again, integrated steel mills provide a salient illustration since they have struggled to adopt the continuous-casting technology introduced by minimills decades ago.) Second, managers who rely on common valuation metrics, such as discounted cash-flow analysis, may underestimate the true benefits of investing in certain types of innovation. Nudged by metrics, they prioritize incremental upgrades with near-term payoffs over innovations with longer time horizons. Finally, managers who rely heavily on ratio-based financial metrics may be tempted to 'manage by the metrics' (a variation on 'managing by the numbers'). To improve a metric, for

example, managers can opt for the more straightforward path of shrinking the denominator (by shedding assets from the balance sheet) over increasing the numerator (by investing in innovation). In a contemporary illustration of this phenomenon, a senior Boeing engineer blamed 'managing by the metrics' for upper management's decision to outsource nearly all production of the 787 aircraft so as to increase return on net assets (RONA) (Hart-Smith, 2001); his assertion was later vindicated by Boeing's CEO (Gates, 2011).

These emerging insights into the implications of metrics for disruptive innovation, in conjunction with the literature on technology assessment, have laid the groundwork for several promising directions for future research. First, researchers could develop a framework that specifies the scope and limits of various metrics for evaluating innovation projects. To overcome the natural tendency to prioritize sustaining innovations, organizations may adopt structures that insulate disruptive innovation efforts from traditional evaluation metrics—perhaps by encouraging small-scale design and tests of new, low-margin product or service offerings targeted at current non-consumers. Second, given that a firm's innovation strategy depends on the projects it invests in, we posit that an integrated approach that combines strategy and finance might reduce impediments to innovation that arise from addressing these considerations separately. Research could specify the optimal array of financial instruments and metrics, each with specific time horizons and risk limits, to enable innovation. Third, researchers could develop new tools and measures to evaluate success—metrics that do not automatically bias incumbents toward sustaining innovations that will pay off in the near term. Entrepreneurship theories may be a unique source of insight, since startups are evaluated differently by stakeholders than large incumbents. Research on business ecosystems has begun to explore similar challenges of relying upon traditional metrics in network-based industries (Altman and Tushman, 2017). By exploring novel metrics, researchers stand to contribute to disruptive innovation theory and to help managers charged with setting the innovation agenda for their companies.

DISCUSSION

We opened our paper with some simple observations on the intriguing inconsistencies of disruption theory. The original concept seems to have gained widespread currency among practitioners (Christensen et al., 2015) and the foundational research on the topic garners frequent citations by academics. At the same time, the theory's core concepts remain widely misunderstood (Christensen, 2006; Raynor, 2011a), and citation patterns indicate a lack of direct engagement with key ideas and terminology (Figure 1). Of particular concern is the underuse of disruptive innovation *as a theoretical concept* upon which management research can profitably build.

Seeking to address these inconsistencies and to invite renewed scholarly attention to disruptive innovation, we undertook two tasks aimed at introducing a coherent perspective on the theory. First, we brought together a diverse and

fragmented literature to trace the intellectual history of disruptive innovation as it has evolved from a technology-change framework—essentially descriptive and relatively limited in scope—to a more broadly explanatory causal theory of innovation and competitive response. Our primary contribution is an updated and integrated conceptualization of disruptive innovation theory, while clarifying several of the underlying constructs and creating a unified theoretical base upon which subsequent researchers can build.

Moreover, to invite renewed academic attention and encourage new research on disruptive innovation in management, we proposed three novel topic areas building upon the newly unified base. Thus, as our second contribution, we articulate productive pathways forward for scholars studying disruptive innovation. By focusing scholarly efforts on incumbent response strategies, factors shaping performance trajectories, and innovation metrics that may contribute to disruption, researchers have the potential to enrich and extend the theory of disruptive innovation. Our review and reconceptualization suggest that these domains are ripe for exploration.

Scope Conditions and Contexts

In this paper, we focus on domains most closely associated with the core tenets of disruption theory. But there are no doubt many others that may be of interest to scholars. For instance, along with its primary focus on product-based settings, disruptive innovation theory has occasionally considered 'facilitated network businesses,' (businesses that operate via a type of platform) (Christensen et al., 2009). While systemic industries have existed for centuries, recent technology advances are enabling them to exist at an unprecedented scale; firms are increasingly relying on these business models in their innovation strategies (Altman et al., 2015; Benkler, 2006). Thus, we believe it is important to consider disruptive innovation theory as it relates to platform-based settings.

We wonder whether a possible connection between disruptive innovation theory and systemic industries relates to the modularity of product architectures (Baldwin, 2008; Baldwin and Clark, 2000). Early in an industry's evolution, when performance-based competition is especially fierce, firms tend not to adopt modular product architectures because standard modular interfaces tend to compromise performance (Baldwin and Clark, 2000). An important insight of disruptive innovation theory is that when products are not yet good enough to satisfy customers' performance requirements, firms rely on internally interdependent integrated product architectures to maximize performance (Christensen and Raynor, 2003). As performance meets and eventually surpasses existing needs, competition shifts to other dimensions. Less-integrated offerings and businesses with modular architectures become viable.

Based on modular architectures, network-based businesses enable independent entities to interact and leverage others' products and services (Parker et al., 2016). In these contexts, disruptive innovations may affect multiple members of

an ecosystem—posing a challenge for new entrants who must gain the support of the very incumbents their innovation disrupts (Ansari et al., 2016). In addition, shifts in technology standards in systemic industries that highly depend on them may affect whether a new offering is disruptive or sustaining. For example, if standards remain constant then new entrants may provide sub-optimal performance to mainstream users, but as new standards emerge these offerings may begin to provide adequate performance for mainstream users (Garud and Kumaraswamy, 1995). Early indications are that entrants in these contexts pursue a dynamic strategy that adjusts between competition and cooperation at different points in time (Ansari et al., 2016; Marx et al., 2014), but at this time we have little understanding as to how disruption theory may inform (and be informed by) research on firms' innovation strategies in these contexts (Hagiu and Altman, 2017; Zhu and Furr, 2016).

CONCLUSION

This paper has sought to update and revise prevailing conceptualizations of disruptive innovation and to suggest opportunities for future research. While charting how a descriptive account of technology change evolved into a normative theory of innovation and competitive response, we have documented recent additions and refinements to the theory's core tenets and have proposed promising avenues for future research. With a newly unified theoretical base and the seeds of a novel research program, we hope to reinvigorate management research on disruption as a theoretical concept. Rather than a definitive or conclusive overview of disruptive innovation, we hope that this paper serves as the opening of a new chapter of research.

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NOTES

[1] Christensen et al. (2015) offers a concise summary: "Disruption describes a process whereby a company with fewer resources is able to successfully challenge established incumbent businesses. Specifically, as incumbents focus on improving their products and services for their most demanding (and usually most profitable) customers, they exceed the needs of some segments and ignore the needs of others. Entrants that prove disruptive begin by successfully targeting those overlooked segments, gaining a foothold by delivering more-suitable functionality—frequently at a lower price. Incumbents, chasing higher profitability in more-demanding segments, tend not to respond vigorously. Entrants then move upmarket, delivering the

performance that incumbents' mainstream customers require, while preserving the advantages that drove their early success. When mainstream customers start adopting the entrants' offerings in volume, disruption has occurred."

[2] We use the word 'anomaly' in the same sense that Gilbert and Christensen (2006) use it to describe 'anomaly-seeking research' or research that involves an ongoing process of observation of behaviors or outcomes not predicted by the model as originally observed, confrontation of these anomalies, and inductive explanation that seeks to define the circumstances under which the theory holds (pp. 72-73).

[3] Following Winter (1963) and Hannan and Freeman (1977) we distinguish between "firm exit" and "loss of industry leadership." Disruption theory is more concerned with the latter than the former. The prevalence of disruption therefore cannot simply be measured in terms of firm exit (Christensen, 2006).

[4] Business models were not part of the original conceptualization of disruptive innovation, and were incorporated into the model later (see Christensen, 2006).

[5] In common parlance (and sometimes in scholarly work), any innovation in which incumbents stumble and a market reshuffling occurs is called disruptive. By our definition, an innovation can be disruptive regardless of its outcome (Christensen, 2006; Raynor, 2011a).

[6] Here we draw a distinction between 'anomalies' to theory (as defined in endnote 3) and 'exceptions' to theory. As Gilbert and Christensen (2006, p. 79) explain: "There is a tendency among some researchers to cite 'exceptions' to a theory's predictions as evidence that it is invalid. Not all exceptions are anomalies. For example, the observation that airplanes fly is an exception to the general assertion that the earth's mass pulls things down toward its core. Do these exceptions disprove the law of gravity? No. The fact that aviators need airfoils that harness Bernouilli's principle in order to counteract the pull of gravity is an exception that supports the theory. In the realm of management, does the observation that Hewlett Packard, the leading maker of laser printers, also became the leading vendor of disruptive ink-jet printers invalidate [disruption theory]?…Even though this is an exception to the general tendency Christensen observed, it is not an anomaly because HP had to create an autonomous business unit for ink-jet printers in order to cope with the forces he described. Yin (1984) distinguished between literal replication of a theory—instances where the outcome is exactly what the theory predicts—and theoretical replications, where the predicted outcome did not occur, but for reasons that the theory can explain. Airplanes flying and Hewlett Packard are both theoretical replications of the respective theories. It is when an exception is observed that a theory cannot account for as a literal or a theoretical replication, then an anomaly has been identified."

[7] Some have suggested that the strategies adopted by certain high-profile entrants constitute a special type of disruption—an anomaly with which disruption theorists need to grapple. From our perspective, the notion of high-end or "top-down disruption" (Carr, 2005) is incompatible with several important premises of the theory of disruptive innovation (Christensen et al., 2015). However, we do not preclude the possibility that future research could develop new theory to account for these phenomena (see Zuckerman, 2016 for a thoughtful treatment of this subject).

[8] Researchers have observed up-market movement by both incumbents and disruptive entrants in industries as diverse as steel, hydraulic excavators, consumer banking, automobiles, and retail department stores (see Christensen, 1997; Christensen and Raynor, 2003). One explanation is that incumbents 'flee' up-market to pursue more profitable customers at higher tiers of the market, and to enhance profitability by replacing lower-margin business with higher-margin business. Another explanation holds that as incumbents leave successive tiers of the market, margins collapse—creating a vacuum that pulls entrants up-market in search of more profitable customers.

[9] In past work there is often a presumption that incumbents must engage with disruptive innovations before being disrupted. But in responding, incumbents may make errors of commission as well as errors of omission (Garud et al., 1997). And while the latter has usually been the focus in disruption research, the former also warrants consideration. For example, an established firm can make an error of commission by attempting to launch a disruptive business within the processes and priorities embedded in its existing business model (Gilbert and Bower, 2002), or by taking steps that inadvertently dismantle its unique value network (see Garud and Munir, 2008). We are grateful to the editors and to an anonymous reviewer for bringing this distinction to our attention.

[10] Some scholars have argued that the original steamship builders may have also begun with a hybrid product—a steamship outfitted with sails (Foster, 1986). But unlike incumbent sailing-ship manufacturers, these upstarts deployed it as a disruptive innovation, targeting a fringe customer group and new application in the inland-waterway market rather than the mainstream transoceanic-shipping market, thus enabling them to grow and eventually supplant the incumbent sailing ship manufacturers.

[11] Phenomena akin to 'overshoot' have been noted by researchers in adjacent fields. For instance, Freidson (2001) observed a similar dynamic in the medical professions and Abbott (1988) in the professions more generally. We appreciate an anonymous reviewer for pointing this out.

[12] The fact that La Quinta and Holiday Inn Express have introduced junior suites does not imply these discount hotel chains are on a disruptive path, which threatens the market leadership of high-end hotels. Discount chains' business models enable them to profitably serve the low-end. But as they move up-market (e.g., by introducing upscale hotels or better amenities), they face the same tradeoffs as incumbents. Raynor (2011a) elaborates that for these hotels, "the only way to have a concierge is to hire a concierge, and the only way to have a better concierge is to hire a better concierge. Typically, incumbents do that better than entrants." Crowne Plaza (an upscale hotel chain initiated by Holiday Inn), according to Raynor, is "a solid competitor in a challenging industry, but it is not a disruptor." (p. 93).

REFERENCES

Abbott, A. (1988). *The System of Professions: An Essay on the Division of Expert Labor.* Chicago, IL: University of Chicago Press.

Adner, R. (2002). 'When are technologies disruptive? A demand-based view of the emergence of competition'. *Strategic Management Journal,* **23**, 667–88.

Adner, R. and Kapoor, R. (2016). 'Innovation ecosystems and the pace of substitution: Re-examining technology S-curves'. *Strategic Management Journal,* **37**, 625–48.

Adner, R. and Snow, D. (2010). 'Old technology responses to new technology threats: Demand heterogeneity and technology retreats'. *Industrial and Corporate Change,* **19**, 1655–75.

Adner, R. and Zemsky, P. (2006). 'A demand-based perspective on sustainable competitive advantage'. *Strategic Management Journal,* **27**, 215–39.

Ahlstrom, D. (2010). 'Innovation and growth: How business contributes to society'. *Academy of Management Perspectives,* **24**, 11–24.

Ahlstrom, D. (2015) 'Innovation and growth in emerging economies'. In Austrian Council for Research and Technology Development (Ed.). *Designing the Future: Economic, Societal* and *Political Dimensions of Innovation.* Vienna, Austria: Echomedia, 353–87.

Altman, E. J. and Tripsas, M. (2015). 'Product to platform transitions: Implications of organizational identity'. In Shalley, C., Hitt, M. and Zhou, J. (Eds), *Oxford Handbook of Creativity, Innovation* and *Entrepreneurship: Multilevel Linkages.* Oxford: Oxford University Press, 379–94.

Altman, E. J. and Tushman, M. L. (2017). 'Platforms, open/user innovation, and ecosystems: A strategic leadership perspective'. In Furman, J. L., Gawer, A., Silverman, B. S. and Stern, S. (Eds), *Advances in Strategic Management: Entrepreneurship, Innovation, and Platforms, (vol. 37).* Bingley: Emerald Group Publishing Ltd, 177–207.

Altman, E. J., Nagle, F. and Tushman, M. L. (2015). 'Innovating without information constraints: Organizations, communities, and innovation when information costs approach zero'. In Shalley, C., Hitt, M. and Zhou, J. (Eds), *Oxford Handbook of Creativity, Innovation, and Entrepreneurship: Multilevel Linkages.* Oxford: Oxford University Press, 353–78.

Ansari, S. and Garud, R. (2009). 'Inter-generational transitions in socio-technical systems: The case of mobile communications'. *Research Policy,* **38**, 382–92.

Ansari, S., Garud, R. and Kumaraswamy, A. (2016). 'The disruptor's dilemma: TiVo and the U.S. television ecosystem'. *Strategic Management Journal,* **37**, 1829–53.

Anthony, S. D., Johnson, M. W., Sinfield, J. V. and Altman, E. J. (2008). *The Innovator's Guide to Growth: Putting Disruptive Innovation to Work*. Boston, MA: Harvard Business Press.

Baldwin, C. Y. (2008). 'Where do transactions come from? Modularity, transactions, and the boundaries of firms'. *Industrial and Corporate Change,* **17**, 155–95.

Baldwin, C. Y. and Clark, K. B. (2000). *Design Rules*. Cambridge, MA: MIT Press.

Battilana, J. and Dorado, S. (2010). 'Building sustainable hybrid organizations: The case of commercial microfinance organizations'. *Academy of Management Journal,* **53**, 1419–40.

Battilana, J. and Lee, M. (2014). 'Advancing research on hybrid organizing–Insights from the study of social enterprises'. *Academy of Management Annals,* **8**, 397–441.

Bazerman, M. H. (2005). 'Conducting influential research: The need for prescriptive implications'. *Academy of Management Review,* **30**, 25–31.

Benkler, Y. (2006). *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven, CT: Yale University Press.

Benton, J. (2014). 'The leaked New York Times innovation report is one of the key documents of this media age'. *Nieman Journalism Lab*. Available at: http://www.niemanlab.org/2014/05/the-leaked-new-york-times-innovation-report-is-one-of-the-key-documents-of-this-media-age/ (accessed 1 May 2018).

Bergek, A., Berggren, C., Magnusson, T. and Hobday, M. (2013). 'Technological discontinuities and the challenge for incumbent firms: Destruction, disruption or creative accumulation?'. *Research Policy,* **42**, 1210–24.

Bermiss, Y. S., Hallen, B. L., McDonald, R. and Pahnke, E. C. (2017). 'Entrepreneurial beacons: The Yale endowment, run-ups, and the growth of venture capital'. *Strategic Management Journal,* **38**, 545–65.

Bower, J. L. (1970). *Managing the Resource Allocation Process: A Study of Corporate Planning and Investment*. Boston, MA: Harvard Business School Press.

Bower, J. L. and Christensen, C. M. (1995). 'Disruptive technologies: Catching the wave'. *Harvard Business Review,* **73**, 43–53.

Burgelman, R. A. (1991). 'Intraorganizational ecology of strategy making and organizational adaptation: Theory and field research'. *Organization Science,* **2**, 239–62.

Burgelman, R. A. (1994). 'Fading memories: A process theory of strategic business exit in dynamic environments'. *Administrative Science Quarterly,* **39**, 24–56.

Burgelman, R. A. (1996). 'A process model of strategic business exit: Implications for an evolutionary perspective on strategy'. *Strategic Management Journal,* **17**, 193–214.

Burgelman, R. A. and Grove, A. S. (2007). 'Cross-boundary disruptors: Powerful interindustry entrepreneurial change agents'. *Strategic Entrepreneurship Journal,* **1**, 315–27.

Burt, R. S. and Ronchi, D. (2007). 'Teaching executives to see social capital: Results from a field experiment'. *Social Science Research,* **36**, 1156–83.

Carr, N. (2005). 'Top-down disruption'. *Strategy+Business,* **39**, 1–5.

Charitou, C. D. and Markides, C. C. (2003). 'Responses to disruptive strategic innovation'. *MIT Sloan Management Review,* **44**, 55–63.

Chen, E. L., Katila, R., McDonald, R. and Eisenhardt, K. (2010). 'Life in the fast lane: Origins of competitive interaction in new vs. established markets'. *Strategic Management Journal,* **31**, 1527–47.

Chesbrough, H. (2002). 'Graceful exits and missed opportunities: Xerox's management of its technology spin-off organizations'. *Business History Review,* **76**, 803–37.

Christensen, C. M. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Boston, MA: Harvard Business School Press.

Christensen, C. M. (2006). 'The ongoing process of building a theory of disruption'. *Journal of Product Innovation Management,* **23**, 39–55.

Christensen, C. M. and Bower, J. L. (1996). 'Customer power, strategic investment, and the failure of leading firms'. *Strategic Management Journal,* **17**, 197–218.

Christensen, C. M. and Raynor, M. (2003). *The Innovator's Solution: Creating and Sustaining Successful Growth*. Boston, MA: Harvard Business School Press.

Christensen, C. M. and Sundahl, D. (2016). *Anomalies Wanted: Good Theory and the Pursuit of Predictability*. Boston, MA: Harvard Business School.

Christensen, C. M. and Tedlow, R. S. (2000). 'Patterns of disruption in retailing'. *Harvard Business Review,* **78**, 42–45.

Christensen, C. M., Suárez, F. F. and Utterback, J. M. (1998). 'Strategies for survival in fast-changing industries'. *Management Science,* **44**, S207–20.

Christensen, C. M., Raynor, M. and Verlinden, M. (2001). 'Skate to where the money will be'. *Harvard Business Review,* **79**, 72–81.

Christensen, C. M., Aaron, S. and Clark, W. (2003). 'Disruption in education'. In Devlin, M., Larson, R. and Meyerson, J. (Eds), *The Internet and the University: Forum, 2001*. Boulder, CO: EDUCAUSE and the Forum of the Future of Higher Education, 19–44.

Christensen, C. M., Anthony, S. D. and Roth, E. A. (2004). *Seeing What's Next: Using the Theories of Innovation to Predict Industry Change*. Boston, MA: Harvard Business Press.

Christensen, C. M., Kaufman, S. P. and Shih, W. C. (2008). 'Innovation killers'. *Harvard Business Review,* **86**, 98–105.

Christensen, C. M., Grossman, J. H. and Hwang, J. (2009). *The Innovator's Prescription: A Disruptive Solution for Health Care*. New York: McGraw-Hill.

Christensen, C. M., Alton, R., Rising, C. and Waldeck, A. (2011). 'The new M&A playbook'. *Harvard Business Review,* **89**, 48–57.

Christensen, C. M., Wang, D. and Van Bever, D. (2013). 'Consulting on the cusp of disruption'. *Harvard Business Review,* **91**, 106–14.

Christensen, C. M., Raynor, M. and McDonald, R. (2015). 'What is disruptive innovation?'. *Harvard Business Review,* **93**, 44–53.

Danneels, E. (2004). 'Disruptive technology reconsidered: A critique and research agenda'. *Journal of Product Innovation Management,* **21**, 246–58.

Danneels, E. (2006). 'From the Guest Editor: Dialogue on the Effects of Disruptive Technology on Firms and Industries'. *Journal of Product Innovation Management*, **23**, 2–4.

d'Arbeloff, A. (1996). *Teradyne: Corporate Management of Disruptive Change*. Working Paper HBS# 9-398-121, Harvard Business School, Cambridge, MA.

Das, S. (2017). *Banking on Disruption: Digitization, FinTech and the future of retail banking*. Available at: https://www.christenseninstitute.org/wp-content/uploads/2017/06/Digitization-FinTech-and-the-future-of-retail-banking-1.pdf (accessed 1 May 2018).

Dechow, P. M. and Sloan, R. G. (1991). 'Executive incentives and the horizon problem: An empirical investigation'. *Journal of Accounting and Economics,* **14**, 51–89.

Di Stefano, G., Gambardella, A. and Verona, G. (2012). 'Technology push and demand pull perspectives in innovation studies: Current findings and future research directions'. *Research Policy,* **41**, 1283–95.

Dosi, G. (1982). 'Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change'. *Research Policy,* **11**, 147–62.

Eisenmann, T., Parker, G. and Van Alstyne, M. W. (2006). 'Strategies for two-sided markets'. *Harvard Business Review,* **84**, 92–101.

Foster, R. N. (1986). 'Working the S-curve: Assessing technological threats'. *Research Management,* **29**, 17–20.

Freidson, E. (2001). *Professionalism, the third logic: On the practice of knowledge*. Chicago, IL: University of Chicago Press.

Furr, N. R. and Snow, D. C. (2015a). 'Intergenerational hybrids: Spillbacks, spillforwards, and adapting to technology discontinuities'. *Organization Science,* **26**, 475–93.

Furr, N. and Snow, D. (2015b). 'The Prius approach'. *Harvard Business Review,* **93**, 102–07.

Gans, J. (2016). *The Disruption Dilemma*. Cambridge, MA: The MIT Press.

Garud, R. and Ahlstrom, D. (1997). 'Technology assessment: A socio-cognitive perspective'. *Journal of Engineering and Technology Management,* **14**, 25–48.

Garud, R. and Kumaraswamy, A. (1995). 'Technological and organizational designs for realizing economies of substitution'. *Strategic Management Journal,* **16**, 93–109.

Garud, R. and Munir, K. (2008). 'From transactions to transformation costs: The case of Polaroid's SX-70 Camera'. *Research Policy,* **37**, 690–705.

Garud, R., Nayyar, P. R. and Shapira, Z. B. (Eds). (1997). *Technological Innovation: Oversights and Foresights*. Cambridge: Cambridge University Press.

Gates, D. (2011). 'A "prescient" warning to Boeing on 787 trouble'. *Seattle Times*. Available at: http://old.seattletimes.com/html/sundaybuzz/2014125414_sundaybuzz06.html (accessed 1 May 2018).

Gilbert, C. G. (2003). 'The disruption opportunity'. *MIT Sloan Management Review,* **44**, 27–32.

Gilbert, C. G. (2005). 'Unbundling the structure of inertia: Resource versus routine rigidity'. *Academy of Management Journal,* **48**, 741–63.

Gilbert, C. G. (2006). 'Change in the presence of residual fit: Can competing frames coexist?'. *Organization Science,* **17**, 150–67.

Gilbert, C. G. and Bower, J. L. (2002). 'Disruptive change. When trying harder is part of the problem'. *Harvard Business Review,* **80**, 94–101.

Gilbert, C. G., Eyring, M. and Foster, R. N. (2012). 'Two routes to resilience'. *Harvard Business Review,* **90**, 65–73.

Gnyawali, D. R. and Madhavan, R. (2001). 'Cooperative networks and competitive dynamics: A structural embeddedness perspective'. *Academy of Management Review,* **26**, 431–45.

Govindarajan, V. and Kopalle, P. K. (2006). 'The usefulness of measuring disruptiveness of innovations ex post in making ex ante predictions'. *Journal of Product Innovation Management,* **23**, 12–18.

Gulati, R. (2007). 'Tent poles, tribalism, and boundary spanning: The rigor-relevance debate in management research'. *Academy of Management Journal,* **50**, 775–82.

Gulati, R. and Garino, J. (2000). 'Get the right mix of bricks & clicks'. *Harvard Business Review,* **78**, 107–14.

Hagiu, A. and Altman, E. J. (2017). 'Finding the platform in your product: Four strategies that can reveal hidden value'. *Harvard Business Review,* **95**, 94–100.

Hagiu, A. and Wright, J. (2015). 'Marketplace or Reseller?'. *Management Science,* **61**, 184–203.

Hambrick, D. C. (1994). 'What if the academy actually mattered?'. *Academy of Management Review,* **19**, 11–16.

Hart-Smith, J. (2001). *Out-sourced profits - The cornerstone of successful subcontracting*. Presented at Boeing Third Annual Technical Excellence Symposium (TATE Symposium), February 14–15.

Henderson, R. M. (1993). 'Underinvestment and incompetence as responses to radical innovation: Evidence from the photolithographic alignment equipment industry'. *RAND Journal of Economics,* **24**, 248–70.

Henderson, R. M. (2006). 'The innovator's dilemma as a problem of organizational competence'. *Journal of Product Innovation Management,* **23**, 5–11.

Henderson, R. M. and Clark, K. B. (1990). 'Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms'. *Administrative Science Quarterly,* **35**, 9–30.

Hüsig, S., Hipp, C. and Dowling, M. (2005). 'Analysing disruptive potential: The case of wireless local area network and mobile communications network companies'. *R&D Management,* **35**, 17–35.

Kapoor, R. and Klueter, T. (2015). 'Decoding the adaptability–rigidity puzzle: Evidence from pharmaceutical incumbents' pursuit of gene therapy and monoclonal antibodies'. *Academy of Management Journal,* **58**, 1180–207.

Kim, S. K. and Min, S. (2015). 'Business model innovation performance: When does adding a new business model benefit an incumbent?'. *Strategic Entrepreneurship Journal,* **9**, 34–57.

King, A. A. and Baatartogtokh, B. (2015). 'How useful is the theory of disruptive innovation?'. *MIT Sloan Management Review,* **57**, 77–90.

King, A. A. and Tucci, C. L. (2002). 'Incumbent entry into new market niches: The role of experience and managerial choice in the creation of dynamic capabilities'. *Management Science,* **48**, 171–86.

Lant, T. K., Milliken, F. J. and Batra, B. (1992). 'The role of managerial learning and interpretation in strategic reorientation: An empirical exploration'. *Strategic Management Journal,* **13**, 585–608.

Leonard-Barton, D. (1992). 'Core capabilities and core rigidities: A paradox in managing new product development'. *Strategic Management Journal,* **13**, 111–25.

Lucas Jr, H. C. and Goh, J. M. (2009). 'Disruptive technology: How Kodak missed the digital photography revolution''. *Journal of Strategic Information Systems,* **18**, 46–55. '.

MacFarquhar, L. (2012). *When giants fail (on the steel industry bigwigs).* The New Yorker, **88**, 84–95.

Mack, T. and Summers, M. (1999). 'Danger: Stealth attack'. *Forbes,* **163**, 88–92.

Markides, C. (2006). 'Disruptive innovation: In need of better theory'. *Journal of Product Innovation Management,* **23**, 19–25.

Markman, G. D. and Waldron, T. L. (2014). 'Small entrants and large incumbents: A framework of micro entry'. *Academy of Management Perspectives,* **28**, 179–97.

Marx, M., Gans, J. S. and Hsu, D. H. (2014). 'Dynamic commercialization strategies for disruptive technologies: Evidence from the speech recognition industry'. *Management Science,* **60**, 3103–23.

McDonald, R. and Eisenhardt, K. (2017). *Parallel Play: Startups, Nascent Markets, and the Search for a Viable Business Model.* Working Paper No. 14-088, Harvard Business School, Boston, MA.

McElheran, K. (2015). 'Do market leaders lead in business process innovation? The case(s) of e-business adoption'. *Management Science,* **61**, 1197–216.

Nair, A. and Ahlstrom, D. (2003). 'Delayed creative destruction and the coexistence of technologies'. *Journal of Engineering and Technology Management,* **20**, 345–65.

O'Reilly, C. A. I. I. I. and Tushman, M. L. (2008). 'Ambidexterity as a dynamic capability: Resolving the innovator's dilemma'. *Research in Organizational Behavior,* **28**, 185–206.

O'Reilly III, C. A. and Tushman, M. L. (2016). *Lead and Disrupt: How to Solve the Innovator's Dilemma.* Stanford, CA: Stanford University Press.

Pahnke, E., McDonald, R., Wang, D. and Hallen, B. (2015). 'Exposed: Venture capital, competitor ties, and entrepreneurial innovation'. *Academy of Management Journal,* **58**, 1334–60.

Parker, G. G., Van Alstyne, M. W. and Choudary, S. P. (2016). *Platform revolution*, 1st ed. New York: W.W. Norton & Company.

Pfeffer, J. and Salancik, G. R. (1978). *The External Control of Organizations: A Resource Dependence Perspective*. New York: Harper & Row.

Rachleff, A. (2013). 'What disrupt really means'. *Tech Crunch*. Available at: https://techcrunch.com/2013/02/16/the-truth-about-disruption/ (accessed 1 May 2018).

Raffaelli, R. (2018). 'Technology reemergence: Creating new markets for old technologies, Swiss mechanical watchmaking 1970–2008'. *Administrative Science Quarterly*. https://doi.org/10.1177/0001839218778505.

Rao, B., Angelov, B. and Nov, O. (2006). 'Fusion of disruptive technologies: Lessons from the skype case'. *European Management Journal,* **24**, 174–88.

Raynor, M. E. (2011a). *The Innovator's Manifesto: Deliberate Disruption for Transformational Growth*, 1st ed. New York: Crown Business.

Raynor, M. E. (2011b). 'Disruption theory as a predictor of innovation success/failure'. *Strategy & Leadership,* **39**, 27–30.

Rosenbloom, R. S. and Christensen, C. M. (1994). 'Technological discontinuities, organizational capabilities, and strategic commitments'. *Industrial and Corporate Change,* **3**, 655–85.

Sandström, C., Magnusson, M. and Jörnmark, J. (2009). 'Exploring factors influencing incumbents' response to disruptive innovation'. *Creativity and Innovation Management,* **18**, 8–15.

Slater, S. F. and Narver, J. C. (1998). 'Customer-led and market-oriented: let's not confuse the two'. *Strategic Management Journal,* **19**, 1001–06.

Sood, A. and Tellis, G. J. (2005). 'Technological evolution and radical innovation'. *Journal of Marketing,* **69**, 152–68.

Sood, A. and Tellis, G. J. (2011). 'Demystifying disruption: A new model for understanding and predicting disruptive technologies'. *Marketing Science,* **30**, 339–54.

Stone, B. (2013). *The Everything Store: Jeff Bezos and the Age of Amazon*. New York: Little, Brown and Company.

Tripsas, M. (1997). 'Unraveling the process of creative destruction: Complementary assets and incumbent survival in the typesetter industry'. *Strategic Management Journal,* **18**, 119–42.

Tushman, M. L. and Anderson, P. (1986). 'Technological discontinuities and organizational environments'. *Administrative Science Quarterly,* **31**, 439–65.

Tushman, M. L. and O'Reilly, C. A. III. (2007). 'Research and relevance: Implications of Pasteur's quadrant for doctoral programs and faculty development'. *Academy of Management Journal,* **50**, 769–74.

Utterback, J. M. (1994). *Mastering the Dynamics of Innovation: How Companies Can Seize Opportunities in the Face of Technological Change*. Boston, MA: Harvard Business School Press.

Utterback, J. and Acee, H. J. (2005). 'Disruptive technologies: An expanded view'. *International Journal of Innovation Management,* **9**, 1–17.

Wessel, M. and Christensen, C. M. (2012). 'Surviving disruption'. *Harvard Business Review,* **90**, 56–64.

Westerman, G., McFarlan, F. W. and Iansiti, M. (2006). 'Organization design and effectiveness over the innovation life cycle'. *Organization Science,* **17**, 230–38.

Zhao, E. Y., Fisher, G., Lounsbury, M. and Miller, D. (2017). 'Optimal distinctiveness: Broadening the interface between institutional theory and strategic management'. *Strategic Management Journal,* **38**, 93–113.

Zhu, F. and Furr, N. (2016). 'Products to platforms: Making the leap'. *Harvard Business Review,* **94**, 72–78.

Zuckerman, E. W. (2016). 'Crossing the chasm to disruptive innovation'. *MIT Sloan Management Review,* **58**, 28–30.