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Disruptive Innovation: A Historical Review and Recent Developments

Abstract

RESEARCH OBJECTIVE: This paper aims to summarize and discuss key findings in the literature around the concept of disruption or disruptive innovation and how the ad hoc academic knowledge evolved in the recent couple of decades.

THE RESEARCH PROBLEM AND METHODS: The research method is based on historical and critical literature review. Hence, this paper discusses other scholars' research and findings around the topic of disruption innovation.

THE PROCESS OF ARGUMENTATION: This paper starts with a summary of Christensen's disruption theory (1997) followed by some important clarifications of ad hoc definitions. Then it inspects some of this theory weaknesses highlighted in the literature before investigating the main recent developments in the last couple of decades and the related research venues.

RESEARCH RESULTS: Despite the positive efforts made by many scholars to reconcile Christensen's disruption theory (1997) with the reality of the market and empirical data and to clarify the concept of disruption and its numerous implications and frameworks, some fuzziness and many gaps are still persisting in the extant literature. Namely, a normalized and exhaustive disruption framework seems to be missing hitherto.

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CONCLUSIONS, INNOVATIONS, AND RECOMMENDATIONS:

This paper provides a refined picture of the academic discussion around disruption innovation, and is hence a useful starting point for researchers interested in topics related to “innovation management” who would like to investigate further avenues of research directly or indirectly linked to disruption.

KEYWORDS:

disruptive innovation, technology, business model,
ambidexterity, incumbents, entrants

**1. INTRODUCTION AND METHODOLOGICAL
ASSUMPTIONS**

In a world characterized by its Volatility, Uncertainty, Complexity and Ambiguity – also known as a VUCA world (Horney et al., 2010), businesses are expected to innovate at a higher frequency than ever before. Innovation has become a building block of most competitive advantages (Hill & Jones, 1998, p. 166), not only on local, regional or domestic markets (Kosała & Wach, 2014), but especially while operating on international markets (Wach, 2016). In this same context, the concept of disruption has been widely used – and often misused, by business managers, executives and academics to describe an innovation or a technology with high economic impact or potential. Back to its first origins, Abernathy (1976) first introduced the productivity dilemma arguing that there is a trade-off between a corporation’s short-term objectives related to monetizing existing products, and long-term goals aggregated around developing new products. Two decades later, disruption innovation was diffused by the American scholar Clayton M. Christensen (1995). This latter argued that well-established companies are faced with a challenging dilemma: focusing on satisfying and retaining the current customers OR investing in innovative products aiming customers’ future expectations. This same dilemma can be translated in the difference between an incremental or evolutionary innovation AND a disruptive or revolutionary one (Christensen, 1997). So according to Christensen, a company could choose to implement small

and continuous improvements to its product(s) and service(s) so that it secures and gradually enhance its mainstream market share. On the other hand, the core dilemma it faces is financial. In fact, disruptive innovations “look financially unattractive to established companies. The potential revenues look small, and unlikely to make a meaningful contribution to corporate growth. And the high cost structures of established companies means it is more viable to work with sustaining rather than disruptive technologies” (Christensen & Bower, 1995). Moreover, the performance of disruptive technologies is generally worse along one or two dimension that are important to current customers at the time of its introduction (Christensen & Bower, 1995). The manifestation of the dilemma happens when this disruption innovation offer new growth opportunities, opens new markets and finally conquers old ones.

Catching up with nowadays fast-paced business world and technological changes, this paper’s main objective is to display how the discussion around disruption innovation evolved in the literature since Christensen’s era, while paying particular attention to the developments and findings from the last decade in order to draw practical and updated conclusions about the familiarity of the initial concept with state-of-the-art developments and to identify some likely directions for future research.

The research methodology is based on historical and critical literature review in the sense that by selecting appropriate papers, we aim to examine research over a period of time, namely starting from the end of the twentieth century, then tracing the evolution of disruption innovation within the related scholarship.

This article contributes to the extant knowledge around the innovator’s dilemma theory and provides scholars with clear enough state of the art picture of the disruptive theoretical ecosystem and the ad hoc gaps that may be investigated in further research.

The paper starts with shedding the light on Christensen’s disruption theory (1997) and clarifying some related definitions before inspecting some weaknesses of this theory expressed by scholars and finally investigating the main recent developments around disruptive innovations and suggesting further research avenues.

2. LITERATURE REVIEW AND THEORY DEVELOPMENT

2.1. The innovator's dilemma by Christensen

A while before Christensen's outstanding publication about disruption innovation, many scholars such as Hannay (1980) had already acknowledged that technological change is one of the most fundamental and powerful forces affecting both the economy and society. Building on the observations made previous his predecessors Cooper and Schendel (1976), Foster hence introduced the S-curve framework in 1986, which was well received by managers and scholars at the time. Foster made the distinction between the Defenders and the Attackers. The former group tries to protect its revenue sources and market share while the latter tends to challenge and disturb the status quo in order to make some profit. Foster (1986) distinguishes four phases in the S-curve: introduction, take-off, maturity and decay (cf. figure 1). In this context, Defenders aim to prevent the switch of customers to the next S-curve by reducing their cost and enhancing their product efficiency while Attackers offer differentiated features in order to ride on a new curve.

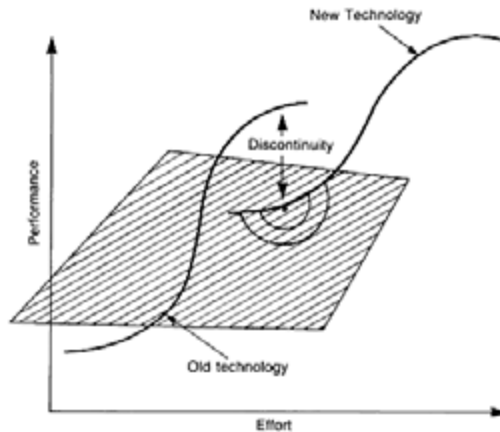


Figure 1. The S-curve.
Source: Foster (1986, p. 31).

In two complementary papers (1992), Christensen explores the limits of the technology S-curve theory with an empirical interest in the disk drive industry. Noticing that most previous studies around technology maturity and S-curve were conducted at the industry level – aircraft engines (Constant, 1980), foam rubber (Roussel, 1984), magnets (Japp, 1991), Christensen tackles the S-curve framework from a manager viewpoint instead of an aggregate high-level perspective. Taking component technology industry as a reference, he also challenges the Attackers' advantage (Foster, 1986) by displaying for instance that some companies that jumped late on the technology S-curves succeeded to match the product performance of the early adopters.

2.2. Incremental, Radical or Disruptive

The discussion about how radical or incremental a technology is started in the late seventies. An innovation that incorporates a technology evolution pattern which is riskier and quite different from the existing one was pointed to as radical (Duchesneau et al., 1979). Making the link with Foster's S-curve theory, this definition of "radicalism" may be translated into a switch from one curve to the upper one, while surfing on the same curve stands for an incremental one. Despite these similarities, as we will check in the next section, a disruptive innovation and a radical one turned out to be different on so many levels. Moving forwards, Tushman and Anderson (1986) made the distinction between competence enhancing and competence-destroying technological changes. Other scholars based their reasoning on the theory of punctuated equilibrium (Gould & Eldredge, 1977) to suggest a demand-side explanation for the phenomenon of disruption (Levinthal, 1998; Adner & Zemsky, 2005). They assumed that disruption occurs when a new technology that starts in one field moves to a new area with potentially higher demand and additional resources.

As mentioned in the introduction, Christensen's theory (1997) about disruptive innovations was the one who gained most of the ground in business and academia (Henderson, 2006; Adner & Zemsky, 2005). It posited that disruption occurred when an initially inferior technology introduced by a new entrant improved gradually to

meet the needs of the mass market and that managers must beware of ignoring new technologies that don't initially meet the needs of their mainstream customers (Bower & Christensen, 1995). From an S-curve perspective again, Christensen (1997) made it clear that a disruptive technology cannot be plotted in the figure 1 because the dimension on the vertical axis is not similar. He suggested for incumbents to make use of the graph below with the help of their customers. If the expected performance improvement trajectory of a potentially disruptive technology surpasses the performance required by mainstream market in a near future, then this technology is probably strategically critical. The innovator's dilemma hence resides in whether to put more effort into the promising technology despite its initial unsatisfactory performance or focusing on retaining current customers and enhancing current technology performance. Due to some extent to this dilemma, although many companies achieve successful innovation, few organizations understand or have established track records for undertaking successful disruptive innovation (Christensen, 1997), and many are reluctant to follow this path (Christensen, 1997; Hamel, 2000; Tushman & Anderson, 1986), thus hesitating to innovate beyond incremental changes.

Based on the disk drive market, Christensen (1997) elaborates more by noticing that by trying to reach a high-end customer expectation related to some performance criterion, an incumbent develops a product that surpasses the performance needs of mid to low-end customers for that criterion. Then comes a disruptive innovation that is just good-enough along the first performance dimension but that is lower cost or performs better along a second dimension. While existing high-end customers avoid the new product, a new market segment (or the existing low-end segment) gladly accepts the new product. Yet, with time, the new competitive product is incrementally enhanced, particularly with regard to the first underrated dimension, till it gains more ground within incumbent's mainstream segment (cf. figure 2).



Figure 2. Illustration of the disruptive process.
 Source: Christensen, Raynor, McDonald (2015, p. 45).

2.3. Weaknesses in Christensen’s theory

Although appealing and well diffused, Christensen’s theory received many academic critiques starting with the meaning of “disruption” itself. Danneels (2004) stated a lack of constructive criticism of the core concept of Christensen’s theory, namely “disruptive technology,” as well as its mechanisms and effects on firms and industries. Moreover, it appears there is an ambiguity in the use of the word “Disruption” as a cause and effect simultaneously (Kostoff et al., 2004). Furthermore, the theory is not clear as to which domain it applies (Danneels, 2004): technology domain (performance evolution), firm domain (competitive survival), or demand domain (market acceptance).

Takahashi et al. (2007; 2013) tackled the data side of the theory. They claimed that Christensen referred to figures and data that displayed an inflated disruption. On the same pages, many scholars point out that the amount of data in Christensen theory does not justify such findings’ generalization to various industries (Govindarajan & Kopalle, 2006; Danneels, 2004). Some call for new research on a “comprehensive list of technologies” to examine “the mechanisms and effects” of disruptive technologies on firms and markets (Danneels, 2004). Another loophole is that the initial disruption theory

was just a statement about correlation. Empirical findings showed that incumbents outperformed entrants in a sustaining innovation context but underperformed in a disruptive innovation context. Yet, the reason for this correlation, i.e. the causal mechanism, was not quite evident (Christensen, Raynor, & McDonald, 2015). Finally, the theory seems to lack a strong predictive ability (Tellis, 2006; Kostoff et al., 2004).

2.4. Disruption beyond technology

In trying to cope with the critiques of the innovator's dilemma theory (1997), Christensen widened the scope of disruption from a purely technological spectrum to business models, products and processes. So instead of limiting the research to the disk drive industry, Christensen and Raynor (2003) listed many products such as airlines, power tools, copiers, and motorcycles, etc. That being said, Markides (2006) warned that, although all of these innovations may be disruptive to incumbents, treating them all as one and the same has actually confused matters considerably. He added that "a disruptive technological innovation is a fundamentally different phenomenon from a disruptive business-model innovation as well as a disruptive product innovation." To display such a difference, let us focus on business model innovation for instance. Christensen and Raynor (2003) argued that a disruption is a continuous process that eventually transports a technology from a low to a high market adoption. Danneels (2004) stated that "disruptive technologies tend to be associated with the replacement of incumbents by entrants." The case looks a bit different when considering a business model disruption. Markides (2006) confirms that "what often happens in the case of a business-model innovation is that the new way of competing in the business grows – usually quickly – to a certain percent of the market but fails to completely overtake the traditional way of competing." Thus, contrary to the technological paradigm defended by Christensen, new business models is not necessarily superior to the ones established companies follow. It may be better to keep focusing on current models instead of switching to the "disruptive" one, depending on a case by case cost/benefit analysis (Markides, 2006).

2.5. Recent developments

Based on global market dynamics, the topic of Innovation management has rationally gained more and more attention from firms and scholars in recent years. Many scholars in this field found it hard to reconcile their findings with the initial disruption theory (1997). Thus, some extended this latter while others came up with new or updated models. For example, it was assumed that disruption comes mainly from low-end Attackers. Yet, “new-market footholds” came to complement the previous story. It states that some disruptions take place in an entirely new value network. It opens a new segment that doesn’t directly threaten incumbent players. New-market disruptions compete against “non-consumption,” so incumbents tend to ignore them instead. Yet, Attackers may end up winning the game by attracting incumbent’s customers as well. In that instance, we can consider the PC disruption (Charitou & Markides, 2003; Christensen & Raynor, 2003).

On another front, researchers also succeeded to explain the causal pathway leading to incumbents outperforming Attackers in sustaining innovations and not in disruptive ones and vice versa. For incumbents, two enlightening insights opened the way. First, interviews with disk drives managers pointed to a particular resource allocation process deep within organizations that favored sustaining innovations. New product initiatives that promised high margins, targeting large markets with identifiable customers received priority over disruptive innovations meant for smaller markets with less well-defined customers – even when senior managers explicitly pushed to target new disruptive markets (Burgelman, 2007). Furthermore, incumbents value sustaining over disruptive innovations because they prioritize their existing customers (Christensen & Bower, 1996). This makes total sense given the fact that firms survive and thrive primarily thanks to their mainstream customers and not to some fuzzy innovative threat targeting a secondary customers’ line. While these two arguments explains why incumbents don’t respond to threats straight away, other scholars described why disruptive entrants eventually moved up-market to challenge incumbents who in turn ceded the market rather than fighting back. Adner (2002) empirically demonstrated that as product performance improves, there is greater overlap

between different market segments. Entrants pursuing low price, high volume strategies are motivated to invade, while incumbents are motivated to retreat to uncontested, higher tiers of the existing market (Adner & Zemsky, 2006).

In this updated context, not every interesting innovation that shakes the market should be labeled “disruption innovation.” UBER, the transportation unicorn valued at more than \$50 billion which provides a mobile marketplace between drivers and customers looking for a ride, is not considered as a disruptive innovation by Christensen, Raynor and McDonald (2015). The fact of the matter is that UBER did not start neither from a low-end nor a new-market foothold position. It did not really aim for a low-end customer in the mainstream market, even though with the growing demand, it diversified its service to this segment. It did not open up a new market because Taxi drivers already existed and their customers are or became also UBER customers. This means that contrary to the theory, UBER built “a position in the mainstream market first and subsequently appealing to historically overlooked segments.” Furthermore, a disruptive technology theoretically starts with inferior performance than current mainstream technology, then improves with time to move over it (Christensen, 1997). This does not really apply to UBER since they always provided a quality application and timely delivery (Christensen, Raynor, & McDonald, 2015).

Another term that UBER example may fit into is “radical innovation.” Again, a disruptive innovation is theoretically targeted at an emerging market with a relatively inferior performance at first, and may not involve the newest technology (Govindarajan, Kopalle, & Danneels, 2011). Conversely, a radical innovation is a new product that is based on a substantially new technology linked to what already exists (Chandy & Tellis, 1998), sometimes targeted at a mainstream market and on other occasions at an emerging one. Govindarajan, Kopalle and Danneels (2011) gave a clear instance with cordless telephones which were a radical innovation relative to wired phones while their customer base remained the same. Some of the findings in this regard suggest that focusing on the either a mainstream or an emerging market orientation could lead to the exclusion of the other and hence to a loss of a certain type of innovation. Some firms are actually able to pursue and benefit from both orientations by

complimenting them, which can provide a wider range of innovations (Govindarajan, Kopalle, & Danneels, 2011). In this case, they are considered ambidextrous with regard to their customers' orientation (Tushman & O'Reilly, 2002).

Fleeting under the radar of incumbents by definition, a disruption can ultimately take over the mainstream segment when moving upmarket. A canonical response suggested in the theory (1997) is to create a separate organizational unit (e.g. spin-off) tasked with developing or commercializing the new innovation. Thanks to its financial and hierarchical independency from the parent firm, this unit can act freely and with more agility in the hope to slow down or/and surpass the disruptive upstarter. Even though this approach has been broadly and empirically supported, new propositions have been presented recently by other scholars. Incumbents may aggressively invest in existing capabilities to extend current performance improvement trajectories in order to slow or delay the onset of disruption (Utterback, 1994), or take action by proactively repositioning to profitable new niches rather than reactively ceding the market (Adner & Snow, 2010). As explained above, ambidexterity or the ability of a firm to simultaneously explore and exploit (Tushman & O'Reilly, 1996), can also be considered an implicit strategy to follow a disruptive and sustainable approach simultaneously while managing conflicts expected to arise from mixing these two types of innovative paradigms (O'Reilly & Tushman, 2016). Another brand-image-based strategy to deal with disruptions is redefine the organization's identity, persuading customers to value incumbents products not on functional dimensions where they are losing the battle but on more emotional aspects attaching them to the brand like nostalgia and authenticity that favor firms with a long history (Raffaelli, 2018). Lastly, incumbents may use their financial power to seek partnerships with disruptors or licensing rights of promising startups' technology once it advances beyond a certain maturity point (Marx, Gans, & Hsu, 2014) or by acquiring them altogether (Christensen, Alton, Rising, & Waldeck, 2011; Sandström, Magnusson, & Jornmark, 2009).

Challenging the limits of Christensen's (1997) theory and standing out from the normal extant literature, Sood and Tellis (2011) developed a new schema identifying key terms and variables objectively and precisely (e.g. Technology; a Technological Attack, Domains of

Disruption, etc.) then tested seven testable hypotheses before developing a predictive model of the disruptive hazard of a new technology. Their data collection seems more comprehensive than prior studies in the field with seven markets and 36 technologies tracked on an average of 50 years. Unaligned with the initial disruption theory (1997), their key findings suggest that “potentially disruptive technologies” are introduced as frequently by incumbents as by entrants, are not cheaper than old technologies and rarely disrupt firms. Furthermore, the hazard of disruption by incumbents is significantly higher than that by entrants. This seems to contradict the older theory claiming that entrants or Attackers are the main actors of disruption and often ultimately succeed to dominate the market. The only finding in line previous disruption research up to that point is the fact that low price of new technologies increases the hazard of disruption. “These results suggest that many aspects of the theory of disruption are exaggerated” (Sood & Tellis, 2011).

Technological innovations aside, Chesbrough H. (2007) noted that “Business models matter. A better business model often will beat a better idea or technology.” Despite the variation in the exact definition of a business model among scholars from “the heuristic logic that connects technical potential with the realization of economic value” (Chesbrough & Rosenbloom, 2002) to “the logic of the firm, the way it operates and how it creates value for its stakeholders” (Casadesus, Masanell, & Ricart, 2010), it remains that the central component of a business model is value: value creation, value delivery, and value appropriation (Sorescu, 2017). Through these channels, an appropriate business model may not only stand for an optimized architecture to design and commercialize new ideas and technologies, but can also be a source of innovation by adding new value through the value chain (Massa & Tucci, 2013). Taking into account the recent technological trends, Chesbrough (2007) above statement is particularly true in the age of Big Data and Artificial Intelligence. It has been demonstrated that data-driven businesses productivity is 5-6 per cent higher than similar organizations who are not utilizing data-driven processes (Brynjolfsson, Mitt, & Kim, 2011). 71 percent of banking firms directly report that the use of big data provides them with a competitive advantage (Turner, Schroeck, & Shockley, 2013). For instance, it is obvious that UBER can deliver more value

to its customers (convenience of access, speed, etc.) than classical taxi drivers through its technology but also innovative data-driven business model.

3. CONCLUSIONS AND FURTHER DISCUSSION

In this paper, we briefly displayed how the initial disruption theory opened many doors for researchers and managers regarding the understanding of this particular type of innovation and the development of new frameworks and tools to predict and exploit a disruptive event. However, as we have described in the above sections, the theory fell short in satisfying different needs and often led to biased or completely false misinterpretations. That been said, many of the shortcomings of the initial theory have been addressed in the past twenty years through a process of anomaly-seeking research. Yet, many scholars and managers still use Christensen's 1997 work as a starting point of their projects and managers rely on it to make strategic decisions when new technology arises (Christensen, Raynor, & McDonald, 2015). This wide usage raises the question of whether the academic and business community is in need of an updated normative theory around the concept of disruption, mostly given the unsettling anomalies and exceptions demonstrated by Sood and Tellis (2011), which add even more doubts to the already criticized initial theory and suggest that the disruption phenomenon is rather random than a purely algorithmic process. So before looking to unify the research under one umbrella, it may be wiser to start inspecting the possibility and rationality of such an endeavor provided the disparities among newcomers or incumbents in funding or investing capacities, markets characteristics and legal environments.

Many implications has been found in this study. Namely, the challenges that arise from being an incumbent and an entrant simultaneously have yet to be fully specified and this is not even a certain way for incumbents to keep dominating their market and scholars has not yet discovered the best answer to entrants' moves (Christensen, Raynor, & McDonald, 2015). In this regard, the already described strategies in this paper stand for a descent start of any research aiming to provide managers with the appropriate decision-making toolkit

to choose the best approach among many when faced with a new disruption threat. Another interesting point can be deduced if we use UBER example again. It seems relevant to apply the disruption theory according to following its rules and criteria. Hence, it is obviously wrong to try to fit UBER or any other similar entrant or Attacker to the theory. This has led to a lot of misuse and misapplication of disruptive frameworks in recent years. What is important to consider though, is the labeling and establishment of a theoretical framework around innovations that are shaking the market they compete in and threatening incumbents but which still can't make it as genuine disruptions according to the extant literature and Christensen's definition. How should managers and scholars predict the hazard of these kinds of innovations? What other dimensions make the difference between a normal disruption and an innovation that dominates the market? Is there a possibility to reconcile both kinds of innovations into one theory, since both result in a market shift and the probable falling of some incumbents?

It goes without saying that this paper has its limitations. The main one relate to the almost exclusive use of papers written in English. Moreover, the nature of the literature review methodology, which is selective by nature, has probably brought about the ignoring of some disruption-related studies and findings which might have been interesting to explore and link with the hereby discussion. Interesting research questions and avenues abound the Big Data domain. Whether if it is about external or internal data, the three characteristics of big data – volume, velocity, and variety – can be noted as sources of competitive advantage in several new business models (Sorescu, 2017). As discussed previously, in the near future, disruptions induced by a business model shift could be more dramatic for incumbents and ad hoc market segments than a disruptive technology. Thus, like technologies, Christensen's theory and its updated versions may get obsolete soon. Should researchers define a framework for data-driven disruptions? What is a data-driven disruption in the first place and how can it be predicted and translated into practical lessons and processes for firm managers? If big data enables firms to offer a new product or service, should they spin it off as an independent division (Christensen, 1997) or incorporate it into their current business model?

Last but not least, it is worth mentioning that even though the focus of this paper was centered on the business aspects of disruption, namely how this latter evolves to affect companies in a particular marketplace and how these players are supposed to detect it and deal with it, it is worth mentioning that disruption innovations impact other external fields such regulations. The new product, technology, or business practice may fall within an agency's jurisdiction but not square well with the agency's existing regulatory framework, resulting in a "regulatory disruption" (Cortez, 2014). The ad hoc discussion gave birth to two lines of thoughts. Many regulatory scholars defend a flexible approach arguing that agencies confronting disruptive innovations should avoid traditional rulemaking and adjudication, and instead rely on "threats" packaged in guidance documents, warning letters, and the like. The opposite line include scholars like Nathan Cortez (2014) who support the traditional method of strict law enforcement through fines and penalties for instance. Based on this dichotomy, many other adjacent research avenues can be explored in this regard. Yet, no in-depth investigation has been done so far – maybe due to the recent character of the topic, and most papers rely mainly on case studies to deduce conclusions and recommendations. Interested scholars may for instance empirically search for the best regulatory or fiscal approach on a defined timescale to deal with disruptive innovations and the expected consequences of each on the market profitability, on customer surplus and on the disruption entire ecosystem.

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