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## A disruption framework

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## ABSTRACT

One of the fundamental dilemmas of modern society is the unpredictable and problematic effect of rapid technological development. Sometimes the consequences are momentous not only on the level of a firm, but also on the level of an entire industry or society. This paper provides a framework to understand and assess such disruptions with a focus on the firm and industry levels. First, we give a generally applicable definition for a disruption as an event in which an agent must redesign its strategy to survive a change in the environment. Then we construct a layered model that spans from basic science to society and enables a systematic analysis of different types of disruption. The model also helps in analyzing the spread of innovations both vertically between layers and horizontally between industries. Thirdly, we introduce three main threats that may lead to a disruption and four basic strategies applicable when a disruption occurs. Finally, the framework is used to study four cases: GSM, GPS, the digitalization of photography, and 3D printing. The main contribution of this paper is the simple yet expressive model for understanding and analyzing the spread of industry-level disruptions through several layers and between industries.

## 1. Introduction

Innovation means different things to different people. However, for most of us innovation has a positive connotation. Disruption is, in turn, a negative term. Thus, there is a kind of internal conflict in the term disruptive innovation. Even more so with the term creative destruction, as coined by Joseph Schumpeter in 1942. Both terms leave open the question of whether the outcome will be socially beneficial or not; the terms hint that some entities will benefit while others will suffer. The role of new technologies in the redistribution of costs and benefits has been apparent from the early 19th century when Luddites fiercely protested the then new textile industry. The dilemma between the necessary actions needed for the continuous development of modern societies and the requests to maintain the status quo and to honor the old traditions has been a central topic in political, social, and economic forums during the last 200 years.

After Schumpeter (1950), discussion about the effects of innovations gradually gained momentum. Diffusion of innovations has been studied since early last century (Tarde, 1903/1969). The concept of the S-curve and adopter categorization by Rogers (1962/2003) has been widely used and referenced. Nevertheless, the terms *disruptive technology* and *disruptive innovation* were seldom used before Clayton Christensen published *The Innovator's Dilemma* in 1997. Per Google Scholar, the numbers of scholarly articles before 1997 mentioning “disruptive

innovation” or “disruptive technology” were 51 and 58, respectively, whereas innovation, overall, was mentioned in close to 100,000 articles. Christensen's book created lots of debate about the nature of disruptions. The number of articles discussing disruptive innovations rose from the level of ten per year in the mid-nineties up to almost 3000 articles in 2015. Obviously, Christensen was able to identify and clarify the nature of an important idea.

Understandably, much of the existing literature focuses on disruptive innovation at the level of an individual technology or a single firm and often delves deep in the specific characteristics of the individual case. Yet historical examples show that truly significant disruptions affect also entire industries and even society: former industrial leaders may vanish and be replaced by new entrants, boundaries between formerly distinct industrial sectors may blur, and the new market conditions emerging from the disruption may require significant adaptations at the level of societies in terms of new institutions and regulation.

The main objective of this paper is to provide a simple yet expressive framework for studying and understanding disruptive changes especially at the level of entire industries. To achieve this, we develop conceptual definitions, a layered framework, and a classification of strategies to cope with different types of disruption. The primary viewpoint of the paper is a combination of technology, business, and consumer behavior. However, because we want to present a general

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framework, we also need to consider social and political processes, as well as scientific and applied research. All definitions and classifications are devised to be applicable on all layers from science to society. Before going to the details of the framework in Section 3, we present a literature review on disruptions in the next section. Additionally, in Section 4 several cases are then analyzed through the presented framework. Finally, the general findings of the cases are presented in Section 5 with a discussion about the need for further studies on business disruptions.

## 2. Literature review and the definition of disruption

Christensen's influence has been most prominent in technology-related business literature. Many books have discussed the interplay between technology and business. For instance, Berkun (2010, p. 62), Isaacson (2014, p. 288), Lessig (2008, p. 143), Naim (2014, p. 71), Norman (1998, p. 235), Rogers (1962/2003, 5th ed., p. 247), and Varian (2004, p. 26) approvingly reference Christensen's original thesis about disruptions. Typically, the attitude in such technical papers is that “disruptive” is a desirable trait, because the choice of the term suggests that the paper is presenting something important and possibly highly valuable. The greater the effect or the more disruptive the innovation, the better.

Christensen's original idea was that an excessive reliance on the known and presumed needs of current customers could be harmful when a novel technology disrupts the market. The conflict between old and new needs may lead to a situation in which the incumbents concentrate on serving the old needs while the new players capture a major portion of the market by serving new needs. However, Christensen's treatise in *The Innovator's Dilemma* has been criticized as cherry picking examples and for the lack of a general classification of disruptions, see Danneels (2004), King and Baartogtokh (2015), Lepore (2014), Markides (2006), Sood and Tellis (2011), and Wadhwa (2015).

Moreover, some business literature about digital disruptions omits Christensen and the concept of disruption. For instance, Evans and Wurster (2000) use terms “blowup” and “deconstruction” to address those cases that Christensen would call disruptions. Similarly, Brynjolfsson and McAfee (2014) only refer to Schumpeter's creative destruction and use the word disruption only occasionally while Kelly (2016) discusses the significant future effects of novel technologies on our lives but does not mention Schumpeter or Christensen at all. Also these books do not stress the difference between *sustaining* and *disruptive* technologies; rather, they consider digitalization and its economic and social effects as a complex process that includes phases of gradual evolution and intermittent rapid changes.

Other kinds of terminology have also been used. *Discontinuous innovation* was widely used before disruptive technology became popular, see Anderson and Tushman (1990), Lynn et al. (1996), Veryzer (1998), and Kaplan (1999). Disruptive is a stronger and more tangible qualifier than discontinuous, which may explain the popularity of disruptive among many fields of inquiry. However, the events discussed under these two terms, disruptive and discontinuous innovations, are very similar.

Various definitions of disruption can be found from literature. Sood and Tellis (2011) state that technology disruption occurs when a new technology exceeds the performance of the dominant technology on the primary dimension of performance. Similar definitions can be found in Govindarajan and Kopalle (2006), Schmidt and Druehl (2008), and Utterback and Acee (2005). Linton (2002) refers to Abernathy and Clark (1985) and states that “Disruptive innovations are based on a different technology base than current practice, thereby destroying the value of existing technical competencies.” Kassicieh et al. (2000), Kostoff et al. (2004), Rothaermel (2002), and Volberda et al. (2011) have provided similar definitions. According to Danneels (2004) “a disruptive technology is a technology that changes the bases of competition by changing the performance metrics along which firms

compete.” Similar definitions are presented by Obal (2013) and Nagy et al. (2016). According to Walsh et al. (2002), Geoffrey Moore has noted in 1991: “disruptive technologies generate discontinuous innovations that require users/adopters to change their behavior in order to make use of the innovation.” Albors-Garrigos and Hervás-Oliver (2014), Lyytinen and Rose (2003), Bessant et al. (2010), Paap and Katz (2004), and Urban et al. (1996) have presented similar kinds of definitions. Sometimes disruptions are initiated by a new business model rather than by new technology, as discussed in Ghezzi et al. (2015), Pisano (2015), Sabatier et al. (2012), and Sosna et al. (2010). Finally, many articles (e.g., Kassicieh et al., 2002; Laplante et al., 2013; Markides, 2006 and Yu and Hang, 2010) discuss several aspects of disruptions without giving one clear definition.

In most of the definitions outlined above, the authors define disruption by searching for the common denominator in a set of disruptions. Instead, we take a conceptual approach that starts with the concept of disruption and aims to give a definition that is applicable for all fields, not only for the business sector. Cambridge Dictionaries Online (2017) gives the following definition for *disrupt*: to prevent something, especially a system, process, or event, from continuing as usual or as expected. An agent, when pursuing some predefined goals, makes intentional decisions and performs some actions that, in turn, affect other entities. Sometimes the effects are disruptive, either intentionally or unintentionally. Thus, a *disruptor* is an agent that disrupts the functioning of some other agents. Those disrupted agents can be called *disruptees*; see, e.g., Christensen (2013) and by Yu and Hang (2008). An agent can thus be a disruptor, a disruptee, or a neutral actor from the perspective of a disruption.

But not all entities are agents. In an ecosystem, a majority of entities stay passive without goals, expectations, or intentions. For instance, although money is an integral part of all business ecosystems, money in and of itself has no intentions; only the owner of the money has intentions. In our framework, *disruptive* is a property of a passive entity that mediates the effects from disruptors to disruptees. An ecosystem is, thus, a medium for disruptions. If one says that an ecosystem is disrupted due to an event, the actual claim is that so many agents in the ecosystem are disrupted that the event has a perceptible influence on the ecosystem as a whole.

As to the term *innovation*, Merriam-Webster (2017) gives two main definitions: 1) the introduction of something new, and 2) a new idea, method, or device. We prefer here the later meaning in which innovation refers to an actual object (e.g., charge-coupled device (CCD) that led to digital cameras) instead of the process initiated by an object. Moreover, we use the term *disruptive innovation* rather than *disruptive technology* because innovation is a broader concept and covers business, institutional, and user-generated innovations.

Thus, we propose the following definitions:

An agent is *disrupted* when the agent must redesign its strategy to survive a change in the environment.

From the perspective of a system, *disruption* is an event in which a substantial share of agents belonging to the system is disrupted.

A *disruptive innovation* is a passive entity that mediates a disruption in a system.

## 3. Framework

As the literature review in the previous section demonstrated, numerous viewpoints and methods have been proposed to assess disruptive innovations. Typically, if someone wants to understand a disruption, she may start either with a specific viewpoint (say, strategic choices within a firm) or with a relevant book or a set of articles. In contrast, our aim is to build a framework that makes it possible to flexibly choose among different viewpoints and different methods and even use several of them in parallel. The framework consists of two parts: first, a model with six layers to assess the dynamics of disruptive

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