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The role of business ecosystems in the building of disruptive innovations

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The Role of Business Ecosystems in the Building of Disruptive Innovations

Abstract

Disruptive innovation is an evolving process whose construction depends on a heterogeneous set of organisations that are interconnected through an ecosystem of relationships. However, the systemic development of disruption innovations remains unexplored. Prior studies have examined the conditions under which disruptive innovation is likely to arise focusing on the internal perspective of the incumbent. Moreover, they have not made distinctions among technology, product and business model innovations, suggesting that all types of innovations follow a similar process to become disruptive. We argue that each type of disruptive innovation requires a different type of business ecosystem for the innovation to take hold and become disruptive. By developing a framework that conceptualizes disruption as a dynamic systemic process we provide an understanding of how potential disruptors create and nurture their ecosystem in order to successfully establish and embed their innovation.

Keywords: Business Ecosystems, Disruptive Innovation, Business Model Innovation, Technology Innovation, Product Innovation.

Introduction

Disruptive innovations have received considerable attention in both the academic and popular literatures, yet to date there are few compelling explanations of what allows an innovation to take hold and become disruptive . Studies have for the most part examined the conditions under which disruptive innovation is likely to arise, focusing especially on the internal perspective of incumbent firms (Christensen, 1997; 2006; Danneels, 2004). We believe that the processes that enable an innovation to become disruptive deserve further examination. As Christensen and Raynor (2003, p. 69) argue ‘‘. . . disruption is a process and not an event . . . it might take

decades for the forces to work their way through an industry but [they] are always at work.'' By developing a framework that conceptualizes the construction of disruption as a process this paper provides an integrated understanding of how potential disruptors create and nurture the business ecosystem in order to establish and embed their innovation so that it achieves disruption. The resulting framework and propositions raise important issues regarding how disruptive innovations are constructed, the types of ecosystem needed for the different category of innovations, and how firms manage the value networks within these ecosystems (Ethiraj, 2007; Kapoor and McGrath, 2014).

The term disruptive technologies was initially used to describe technologies that disrupt existing markets but was later broadened with the phrase disruptive innovation to include technological, product, process and business model innovations (Christensen and Overdorf, 2000, Christensen and Raynor, 2003). Different types of disruption, although they arise in different ways, have been often treated similarly in the literature, resulting in inconsistencies and confusion (Markides, 2006). This paper breaks down disruptive innovation into three categories, technology, product and business models, reflecting the most important industrial needs and academic gaps in order to examine how disruptive innovation is constructed systemically.

The disruptive innovation literature has tended to focus on a static view of the incumbent and the disruptor and not on the evolutionary process of disruption (Adner and Kapoor, 2016). We argue that a firm's unique decisions, actions, and value network influences the impetus for disruptive innovation, thus the disruption is constructed in interactions with other participants in a ecosystem. In other words an innovation only becomes a disruptive innovation once the participants in its ecosystem engage in the disrupting process or are themselves disrupted, or both.

Christensen (1997) views firms as passive actors who interact only with their customers, rather than proactive ones who can reconfigure their value network in a beneficial way. However, to be disruptive an innovation cannot progress by an individual firm in isolation, but rather shapes, and is shaped by, the heterogeneous actors across the innovator's ecosystem (Ansari et al., 2015; Kapoor and Furr, 2015). Without consideration of such ecosystems, the literature is handicapped in offering guidance on disruptive innovation and raises questions regarding the construction of the disruption.

In order to examine the process of the construction of disruption, we draw upon the literature on business ecosystems, which describes an ecology of interdependent firms who depend on each other for their mutual effectiveness and survival (Iansiti and Levien, 2004; Moore, 1996). These interdependencies underlie a firm's ability to disrupt (Adner and Kapoor, 2010) as the business ecosystem co-evolves around the innovation (Moore, 1993). While business ecosystems are regularly discussed in the academic literature, surprisingly little attention has been devoted to the creation of a taxonomy of different types of business ecosystems and of examining how disruptive innovation is constructed within a particular type of business ecosystem (Ansari et al., 2015). Thus an examination of the ecosystem in which an innovation will be embedded in is warranted (Adner and Kapoor, 2016). Furthermore, the competitive dynamics between potential disruptors has rarely been the subject of in-depth discussion. For example the originators of the potentially disruptive innovation may not be the eventual disruptors. By not distinguishing early entrants from late entrants, studies ignore the dynamic evolution of the construction of disruptive innovation.

In this paper we synthesize and extend existing theory of disruption innovation and business ecosystems which, to date, have been disconnected. Prior research identifies the importance of disaggregating the external environment into categories in terms of components and

complements (Adner and Kapoor, 2010; Kapoor and Furr, 2015; Kapoor and Lee, 2013), recognizes the different process of constructing disruptive innovation in different types of innovation (Markides, 2016) and examines the lifecycle and the various roles of a business ecosystem (Moore, 1993; Iansiti and Levien, 2004). The purpose of this research is to bring order to the theoretically fragmented literarature, providing a conceptual framework on how the type of disruptive innovation interacts with characteristics of business ecosystems. Different types of business ecosystems, including stable, dynamic, regulated, unregulated, complex, linear, open or closed, in which a company needs to be embedded have important implications for the construction of a disruption. In practice, these types may co-exist, but it is necessary to identify how and why each type impacts the construction of disruption. The resulting conceptual model and propositions focus on the interdependencies of the different types of ecosystem and disruption, thus presenting a more integrated understanding of their evolution. We suggest that the structure and characteristics of a business ecosystem will contingently enable, or prevent, an innovation from becoming disruptive.

The paper is organized as follows. First, we review the literature on disruptive innovation, focusing on the ambiguities in the literature and how they might be resolved. Next, we discuss business ecosystems and how they may integrate with the theory on disruptive innovation. We develop propositions related to the role of ecosystems in the different types of disruptive innovation. Finally, we conclude with a discussion of the implications of our propositions for disruptive innovation theory and practice.

Disruptive Innovation

Disruptive innovation has long been studied in the innovation management literature (Abernathy and Clark, 1985; Christensen, 1997, 2015; Danneels, 2004). However, a heated

discussion still exists regarding the definition and scope of disruptive innovation (Adner 2002; Christensen and Raynor 2003; Danneels 2004; Govindarajan and Kopalle, 2006; Markides 1998, 2006). Disruption describes “a process whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses” (Christensen et al., 2015, p. 3). Christensen (1997) initially focused on technological innovation and explored the disruption of superior technologies by new technologies. In contrast with the diffusion literature which overlooks the evolution of technology, disruptive innovation theory takes the assumption that both the old and new technologies are dynamic.

Christensen and Raynor (2003) subsequently introduced variations of technology disruptive innovation, for example new-market disruptions and low-end disruptions that extended the focus beyond the case of low price and low performance to the creation of a new market. New-market disruptions focus on a new customer segment and initially compete against non-consumption, and low-end disruptions focus on the more price-sensitive mainstream market (Govindarajan and Kopalle, 2006). Later, Christensen widened the application of the term to include technologies, products and business models (Christensen, 2006; Christensen and Raynor, 2003; Markides, 2006, 2012).

Christensen et al. (2015) claim that all types of disruptive innovations follow a similar path - improvement of a product along a trajectory of sustaining innovation and penetration of the market from niche to mainstream. The innovation process is “less a single event than a process that plays out over time” (Wessel and Christensen, 2012). However, another view is that the characteristics of each type of innovation result in different decisions and actions leading to different paths of evolution. Markides (2006, p.19) suggests that technological, product and business model disruptive innovations “arise in different ways, have different competitive

effects, and require different responses from incumbent firms" (Markides, 2006, p.19). Treating all innovation the same creates inconsistencies and errors in theory (Markides, 2006).

Moreover, the disruptors described in previous studies are almost all small firms or start-ups (Ansari., 2015; Christensen et al., 2015; Yu and Hang, 2010), and incumbents are the firms that get most of their profits from the existing innovation marketed to the mainstream segment (Raffi and Kampas, 2002). However, the early pioneers that are the originators of these innovations may not be the ones that are able to scale them up to mass markets, thus late entrants or incumbents may steal the market from early pioneers and become the actual disruptors (Sood and Tellis, 2011). By not distinguishing the early entrants from the late entrants, studies ignore the dynamic evolution of disruptive innovation. An examination of the evolutionary construction of different types of disruptive innovation is still missing.

Types of Disruptive Innovation

As suggested above Christensen et al. (2015) claim that all disruptive innovations, technological, product, and business models innovation, follow a similar process to enter markets and have similar disruptive effects on incumbent firms. We argue that the different types of innovation may actually take hold in different ways (Habtay, 2012; Markides, 2006). Treating all innovation the same creates inconsistencies and errors in theory (Markides, 2006). Thus we break down disruptive innovations into three categories and develop a framework that show the process of disruptive innovation process evolution in each.

Firstly, technology. This, according to Sood and Tellis (2005), is a platform based on a unique scientific principle, on which firms manufacture products to serve customers' needs in a particular market. Disruptive technology innovation usually emerges from an organization that focuses on R&D activities and unfolds through evolutionary and complex processes that

involve multiple actors (Adner and Zemsky, 2005; Ferrary and Granovetter, 2009). A disruptor may not be the inventor of the technology but an organization that has found a way to use the technology within their own competitive sphere. Disruption occurs when new technologies cross seemingly superior technologies on the primary dimension of performance (Sood and Tellis, 2011). Danneels (2004, p. 247) points out that ‘‘... disruptive technologies tend to be associated with the replacement of incumbents by entrants’’ as established companies within the disruptor’s ecosystem can exploit a disruptive technology only by creating a separate unit which has a distinct strategy and value network from the parent company (Christensen and Raynor, 2003). Technological disruptions may be the basis for the creation of disruptive radical product innovations and business models both within the disruptor’s existing ecosystem but also in ecosystems other than the inventor’s.

A second type of potentially disruptive innovation is a radical product innovation, involving the creation of new-to-the-world products. A radical product innovation involves the development or application of significantly new technologies or ideas into markets (Chandy and Tellis, 1998; Rajesh et al., 2000). Since small firm originators lack the resources and knowledge to achieve the mass needed to be disruptive, they need the support of ecosystem incumbents. Some authors suggest that established companies should not waste valuable resources attempting to create product innovations (Markides 2006). Instead they should leave the originators or late entrants to create these markets and concentrate on consolidating young markets into big, mass markets. Therefore, incumbents should sustain a network of young potential disruptors (Markides, 2006).

A third type of disruptive innovation is the new business model (Markides, 2006; Habtay, 2012). Although the term business model was coined during the 1990s, it has gained growing interest in the last decade, largely by the impact of advances in Information and Communication

Technologies (ICTs) (Zott et al., 2011; Osterwalder, et al., 2005). Business model innovation is ‘a fundamentally new way of competing in an existing business’ (Charitou and Markides, 2003, p.55). Charitou and Markides (2003) demonstrated that is not necessary for an incumbent firm to abandon its existing business model in favor of something new. Firms may choose alternatives strategies including inaction or a disrupt-the-disruptor strategy (Markides, 2006).

Our understanding of what gives rise to disruptive innovation is limited (Ansari et al., 2015). Studies have argued that the failure and replacement of incumbents by entrants is come from the reaction of the incumbent (Ansari and Krop, 2012), thus highlighting the dynamic nature of the process and also the role of different players in the ecosystem. The following section examines these issues in more detail.

Disruptive Innovation Success and Failure

Previous studies on disruptive innovation have tended to focus on the internal perspective of the firm and can be allocated into four categories: the managerial aspects of human resources (Tripsas and Gavetti, 2000); resource allocation processes (Hogan, 2005; Kavadias and Chao, 2007); organisational culture (Henderson, 2006; Tushman and O'Reilly, 2002) and organisational structure (Cohen and Klepper, 1996; Tsai and Wang, 2005).

The managerial aspect of human resources attributes an organization’s failure in rebuffing potentially disruptive innovations to the cognitive frames (Tripsas and Gavetti, 2000) of senior managers who may not understand the promise that a disruptive innovation offers, or the threat that it poses (Henderson, 2006). Moreover, firms can fail to embrace an innovation because of resource dependence in which managers, and their corresponding organizational systems, are locked into perpetuating businesses in which they have accumulated resources (Yu and Hang, 2010). They may fail to see the need for innovation because they listen to their existing

customers who provide the resources, and concentrate on sustaining innovations as a result (Christensen, 2006). They fail to link the development of technological advances to changes in the marketplace (Danneels, 2002). Cultural inertia has also been identified as a factor in disruptive innovation (Christensen and Raynor, 2003; Henderson, 2006; Christensen and Bower 1996). Firms need a strong culture of change for a disruption to be embraced, something which many organisations lack. Finally, organisational structure has been found to influence disruptive innovation once again both promoting and blocking it. Large firms are found to have less fertile ground for innovation (Christensen and Raynor, 2003; Tushman and O'Reilly, 2002), while new firms lack the critical complementary assets to develop disruptive ideas (Rothaermel, 2001).

Disruptive innovation emerges as an outcome of a dynamic process, which evolves as a consequence of the interplay of creating forces and history. Yet, previous research has taken a static insider view of the incubator organisation and failed to take an evolutionary outside approach. The concepts of path creation (Garud and Karnoe, 2001) and path dependence (David, 1985), are useful in understanding how disruptive innovations emerge. New entrants will mindfully deviate from what appears to be the common expectation and act as the creative force of disruptive innovation (Garud and Karnoe, 2001). Subsequently the evolution of the disruptive process is path-dependent, and non-linear, in which small differences in the process cause great differences to results. Put another way, initiatives, historical decisions, actions and events play a major role in the subsequent evolutionary process of a disruptive innovation. The heterogeneous participants that compose the ecosystem (Adner and Kapoor, 2016; Ansari et al., 2015) shape this process through their historical interdependencies and current and future complements within which the focal innovation may be embedded (Adner and Kapoor, 2016). As disruptions are systemic in nature (Ansari et al., 2015) they have great implications for the

ways in which each participant acquires value and for the structure of the value network (Burton et al., 2016).

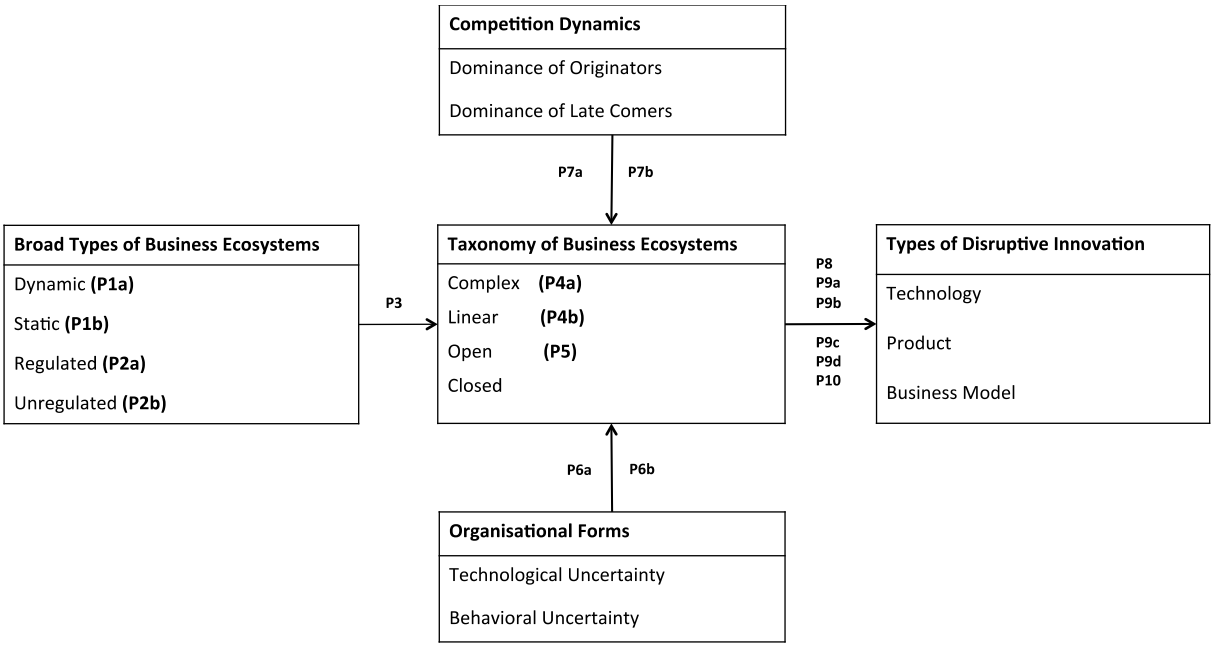
The Role of Business Ecosystem in Disruptive Innovation

A firm seeking to achieve disruptive innovation is dependent upon actions of other partners within its network (Håkansson and Ford, 2002; Gadde et al.,2003). Instead of discussing the effects of disruptive trends for one individual firm, we believe it is more appropriate to discuss the effects for the whole ecosystem (Bharadwaj et al., 2013) something that has rarely been done (Ansari et al., 2015).

In the following sections we develop a set of propositions suggesting the construction of disruptive innovations based on the different types of business and characteristics in terms of context, interconnectedness of components and complementarities, and competitive dynamics and discuss their implications for the different types of disruptive innovations. After the analysis of the different types of business ecosystems, we discuss the implications for the construction of different types of disruptive innovation.Our integrated theoretical framework is presented in Figure 1.

INSERT FIGURE 1 ABOUT HERE

Figure 1. A Process Model of Disruptive Innovation within Business Ecosystems



Business Ecosystems

Tansley (1935) coined the term ecosystem to designate a basic ecological unit composed of both the environment and the organisms that inhabit it. It was taken up again by Moore (1993) to designate business ecosystems. Moore (1993, p.76) defines business ecosystem as "an economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world". Business ecosystems theory highlights the process of co-evolution (Breslin, 2011; Moore, 1993) in which interconnected participants depend on each other for their mutual effectiveness, longevity and propensity for growth (Iansiti and Levien 2004). A healthy business ecosystem will enable individual participants to thrive. Iansiti and Levien (2004) propose three key elements that define a business ecosystem's health: (1) productivity, as the efficiency to transform resources into results; (2) robustness, as the capability to adapt to changes in the environment; and (3) niche creation, as the capacity to create diversity and meaningful novelty.

The literature presents various frameworks examining how business ecosystems are built and managed. These may be summarized into two streams. The first deals with the lifecycle of ecosystems which includes five phases: birth, expansion, maturity, self-renewal, and death (Moore, 1993). In this model stakeholders deploy specific co-operative behaviours over the ecosystem's lifecycle. Following an evolutionary path companies have to co-evolve capabilities around a new innovation. They need to stimulate the birth and expansion of new ecosystems to develop and improve the innovation in order to attract mainstream customers. Developing complementary ecosystems is a powerful mean of broadening and developing a disruptive innovation.

The second research stream deals with the roles of a business ecosystem at the firm level. As Lewin and Regine (1999, p. 207) say, a business ecosystem "is a network of companies each occupying a place on its own landscape of possibilities, and each landscape being coupled to many others: those of competitors, collaborators, and complementors". Different organizations in the business ecosystem can take four roles: keystones, dominators, hub landlords, and niche players (Iansiti and Levien, 2004). Keystones, named from the keystone in a Roman arch, play an essential role in the structure and functioning of an ecosystem. They create and share value with their network and enhance diversity, thereby preserving the ecosystem against encroachment. Dominators control of the ecosystem. They discourage diversity by eliminating other species. As the undisputable center of their ecosystem, they create and capture value for themselves. Hub landlords have low physical presence and extract as much value as possible from the network without playing a strong role in the shaping or power dynamics of the ecosystem. Niche players constitute the bulk of the ecosystem both in mass and variety, while occupying only a narrow part of the network itself. Niche species develop specialised capabilities adding value to the ecosystem as a whole (Iansiti and Levien, 2004).

Based on this categorisation, some studies have tried to explore further the roles within an ecosystem (Rong et al., 2015). However, as Lu et al. (2014) argue previous studies did not consider the merging between stakeholders' roles and the business ecosystem lifecycle, which is an area requiring further research. Business ecosystems also differ in terms of structure, composition, and dynamics, all of which are contingent on its history, in terms of past disturbance, species' arrivals, and management (Wallington et al., 2005). However, none of this theorising has been applied to the path of disruption construction within an ecosystem

Business Ecosystems Types and Disruptive Innovations

From the previous discussion we believe that it is clear that the characteristics of the ecosystem will influence the process of disruptive innovation, and the type of disruptive innovation in turn will influence the characteristics and development of the ecosystem. Some ecosystems are static and others more dynamic (Ansari et al., 2015); some highly regulated and others less so (Cortez, 2014), although very few of these terms are defined properly.

A dynamic business ecosystem welcomes novelty, and promotes the introduction of innovations. There is a great interaction among the participants in the system and change can be generated endogenously. A dynamic ecosystem implies the existence of a competitive market and pressures to innovate. Firms need to cope continuously with the pace of change, and survivors have over time learned how to do this. Dynamic ecosystems are subject to periodic disturbances. On the other hand, a static environment (or relatively static) implies the existence of entrant barriers and lack of competition, which discourages innovations and means that the emergence of a disruptive innovation is likely to be endogenously generated and controlled. Even in the case of disruptions, the ecosystem does return to its original state (Cox and Moore, 2010). As a result we suggest that:

Proposition 1a: *A dynamic business ecosystem is likely to lead to numerous repetitive endogenously-driven disruptive innovations.*

Proposition 1b*: Disruption in a static ecosystem is likely to be driven by exogenous forces.*

A tightly-regulated business ecosystem plays a significant role in constraining or extending the construction of a disruptive innovation (Adner and Kapoor, 2015) and plays a central role in the maintenance of network relationships (Tangpong et al., 2008). Relatively underdeveloped legal structures pose threats to intellectual property rights (IPR) and contracts. Regulatory violations and unfavorable conditions, beyond the control of the individual firm, could halt the path of a disruptive innovation (Peng and Luo, 2000; Wareham et al., 2013). Sometimes, the potentially disruptive innovation may not fit well with the existing regulatory framework and regulators intervene in order to create the framework for new markets to be created, especially for credence goods that are difficult for consumers to evaluate (Cortez, 2014). Innovation disruption might very well be undermined, unless there are antitrust laws. In this ecosystem disruption takes place only with the tacit or explicit support of the regulator(s), thus proposition 2a:

Proposition 2a: *In a regulated ecosystem disruption will be more likely to take hold with the support of the regulatory bodies.*

Proposition 2b: *In an unregulated ecosystem disruption will be more likely to be undermined due to underdeveloped legal structures.*

Bringing the issues of regulation and dynamism together we suggest Proposition 2b:

Proposition 3: *Disruptive innovations will be more likely to take hold in a dynamic environment with developed legal structures.*

Most firms operate in a dynamic environment, where a constant focus on innovation and change is critical. However, even dynamic ecosystems differ: some have high levels of relational interdependencies and others have much weaker, linear, relationships, some are closed and others more open (Moore, 2006; Wareham et al., 2014). Moreover, prior studies have not considered how firms may be organized within the ecosystem in order for disruption to take hold (Kapoor and Lee, 2013). Understanding the ways in which interactions between firms influence ecological communities and their resilience remains an important field of enquiry.

A complex business ecosystem is characterised by relational interdependencies. Such interconnectedness is the sharing or interaction of components necessary to make the product (Adner and Kapoor, 2010; Griffin, 1997; Kaski and Heikkilä, 2002). The level of interconnectedness defines the structure and characteristics of the ecosystem and the evolutionary path of potential disruptors. Interconnectedness requires close relationships between actors. An exogenous innovation developed by a new entrant will need to deal with interaction structures between components and between agents (Carbonell and Rodriguez, 2005; Novak and Eppinger, 2012). Moreover, the novelty of an innovation for which the understanding is low increases the need for interdependencies between firms. In this type of ecosystem a potential disruptor needs to take the role of keystone presiding over significant turnover, increasing richness of various partners, and therefore improving the health of the business ecosystem. Keystones emphasize the collective properties of the business networks in which they are participating in and there is high potential for developing an ecosystem (Iansiti and Levien, 2004).

A linear system, is based on constraint behaviour under strict hierarchical arrangements. The linear ecosystem emphasises what the system can do under specific constraints rather than what is capable of doing when these constraints are lifted (O'Neil et al., 1986). A dominator is

controlling the output of the linear ecosystem and treating business networks in which it participates like traditional supply chain partners (Iansiti and Levien, 2004). The dominator owns a large proportion of a network using vertical or horizontal integration (Iansiti and Levien, 2004). It creates limited value for the system and instead captures value from the ecosystem, stifling innovation. There is little opportunity for a meaningful ecosystem to emerge (Iansiti and Levien, 2004).

The construction of a disruptive innovation by a focal firm, and hence the development of an ecosystem, requires to increase the distributed diversity and productivity in the whole ecosystem (Iansiti and Levien, 2004). An innovation will be unlikely to become disruptive without the support of the dominator. Therefore, we suggest the following propositions.

> ***Proposition 4a:*** *In a complex ecosystem disruptive innovation will have the support of a keystone firm.*
>
> ***Proposition 4b:*** *In a hierarchical/linear ecosystem a dominator firm will prevent disruptive innovation.*

Both complex and linear business ecosystems may be either open or closed. Open ecosystems are where firms have access to complementary assets from the surrounding environment and interact with firms in other ecosystems. Closed ecosystems, on the other hand do not have any complementary inputs from the surrounding environment and do not have any interactions with other ecosystems. Complementary innovation represents an indirect form of interconnectedness in which businesses compete to align themselves with supporting products or technologies. Complementarity occurs when one product requires another aftermarket product (Tatikonda and Stock, 2003). The availability of critical complements will determine whether the offer can create value for users (Adner and Kapoor, 2010). Complementors may need to adapt their activities in order for the new innovation to be developed (Adner and Kapoor, 2010; Casadesus-

Masanell and Yoffie, 2007; Teece, 2007). A firm that is introducing an innovation in an open business ecosystem will need the support of complementors (e.g., Adner and Kapoor, 2010). The level of complementarities defines the structure and characteristics of dynamic business ecosystems and the evolution path of potential disruptors.

> ***Proposition 5:*** *The more open the ecosystem, the more likely it is that disruptive innovation will rely on the availability of complementarities and support of complementors.*

Innovations that integrate various components and partners have to deal with both technological and behavioural uncertainties. Technological uncertainty results from unknown factors regarding any technologies that could emerge or be combined to create a new solution (Dyer et al., 2014). According to Harris and Woolley (2009) innovators encounter technological uncertainty in terms of technology specifications and production processes. These include technical feasibility, functionality or quality, and the skills and knowledge required to succeed in producing or using new technology (Buddelmyer et al., 2010). The uncertainty is partly dependent on the novelty of the technology but also the necessary levels of interconnectedness and complementarities in the business ecosystem. Complementary assets which themselves involve novel technologies are also subject to technological uncertainty, providing what might be described as an uncertainty multiplier effect.

Innovations which involve the production of novel technologies or products, or the use of novel products or technologies produced by other partners, will also be subject to behavioural uncertainty. This pertains to "the difficulty in predicting the actions of other relevant actors, particularly in view of the potential for opportunistic behavior" (Berger et al., 1982, p.2). In contrast to technological uncertainty, which decreases with time, behavioural uncertainty does not (Kapoor and Lee, 2013). Behavioural uncertainty may decrease due to the repeated

interactions which can allow firms to specify better formal contracts (Argyres et al., 2007). On the other hand, behavioural uncertainty may increase; as the market for the offer grows, partners may take advantage of the knowledge gained through the transaction or take advantage of the switching costs.

Previous studies have argued that vertical integration could give the control of the assets to the producer and increase their bargaining power, thereby mitigating the effects of technological and behavioural uncertainty (Novak and Eppinger, 2000). However, vertical integration can instill rigidity into technological trajectories and slow response to new innovation opportunities (Teece, 1996). Therefore, vertical integration should be kept at a minimum. Intrinsic and extrinsic incentives should be given to partners and appropriate governance schemes need to be implemented to reduce technological and behavioural uncertainties and deal with reduced incentives, bureaucratic costs, and influence activities (Kapoor and Lee, 2013).

The suppliers of components and complements may need to undertake new investments and adapt their activities in order for the new innovation to be scaled up and commercialized (Adner and Kapoor, 2010; Casadesus-Masanell and Yoffie, 2007; Teece, 2007). Firms that introduce a potentially disruptive innovation, which by definition will disrupt existing ecosystem dynamics, will almost certainly need the support of the incumbents they will disrupt if the innovation is to take hold. The success of an innovation depends on the ability of other firms in the ecosystem to find value (Adner and Kapoor, 2010). According to Tellis (2006) visionary leadership and the will of the leader to execute that vision is the key issue behind why some innovators thrive while others fail. For an innovator to succeed as a disruptor there needs to be a clear understanding of what can be valued. As Moore (1993) suggests the function of ecosystem leader with a vision is valued by the rest of the community.

Proposition 6a: *The more complex the ecosystem, the more the important it is that technological and behavioural uncertainty is reduced based on incentives provided by the ecosystem leader.*

Proposition 6b: *The more open the ecosystem, the more the important it is that technological and behavioural uncertainty is reduced based on incentives provided by the ecosystem leader.*

Competitive Dynamics among Originators and Late Entrants

Differences in the various types of business ecosystems have important implications for the originator of the innovation. A complex ecosystem increases the learning potential of originators and the barriers to imitation (Adner and Kapoor, 2010). In contrast, if compliments are unavailable this will reduce the innovation leader's potential for gaining disruptive advantage by enabling rivals to catch up (Adner and Kapoor, 2010; Adner and Kapoor, 2013). When the ecosystem is less complex and more open, newly created markets may be invaded by multiple late entrants. The end result of this is that the early pioneers that create innovations are very rarely the ones that scale them up from small niches to big, mass markets. The pursuit of disruptive innovations make most sense in complex settings with available complementarities, in which keystones preside over significant turnover within an ecosystem and promote diversity, which preserve the ecosystem against encroachment from exogenous threats. Therefore, the structure and characteristics of a business ecosystem can enable or prevent, the entrance of potential competitors.

Proposition 7a: *The higher the level of complexity in an ecosystem, the lower the threat of early pioneers from late entrants.*

Proposition 7b: *The higher the level of openness in an ecosystem, the higher the threat of early pioneers from late entrants.*

In this section we have discussed some of the issues that may influence the path of an innovation through an ecosystem as it becomes disruptive to a competitive field. Understanding the ways in which interactions between organisations influence this process is critical, and under-researched. A firm seeking to achieve potential disruptive innovation depends upon actions of other partners within the network of which it is a part (Håkansson and Ford, 2002; Gadde et al., 2003). However, these issues are likely to be contingent on the different types of disruptive innovation. The following section discusses the role of the ecosystem in shaping the evolution of disruptive technology, product and business model innovations.

The Construction of Different Types of Disruptive Innovation

Our paper highlights the evolution of the disruptor's innovation alongside the evolution of roles and relationships within the ecosystem. Although there has been increasing interest in both practice and academia to find ways to manage business ecosystems (Adner, 2006; Dhanaraj and Parkhe, 2006; Iansiti and Levien, 2004), the literature concerning the management of innovation ecosystems is still underdeveloped. How, for example, innovation originators can stimulate the emergence or creation of a supportive ecosystem of suppliers and complementors in order to construct disruption is not well understood (Moore, 1993). Who these ecosystem players are, and the roles and form they take, are likely to be contingent on the type of innovation developed as we discuss in the following section. By examining the characteristics of each type of disruptive innovation (see Figure 2) we can generate a more robust set of insights concerning the type of ecosystem elements which need to be in place and create a taxonomy of innovation-contingent ecosystem structures.

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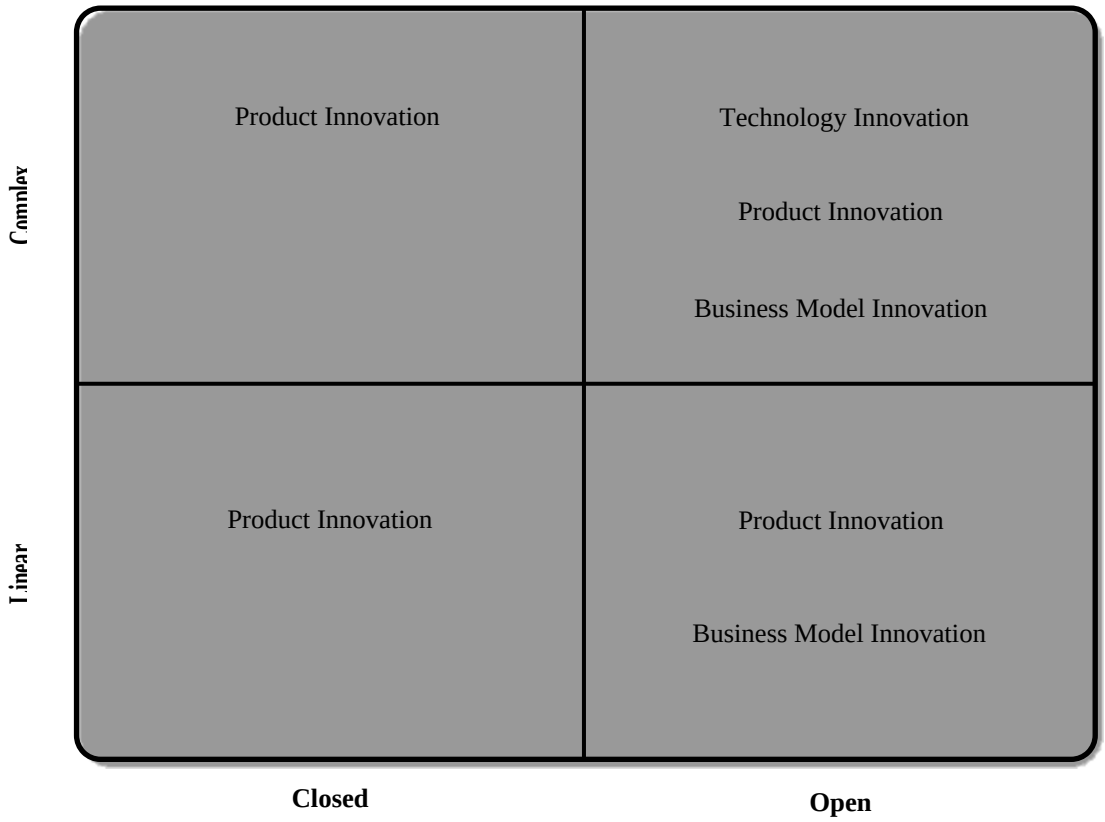
INSERT FIGURE 2 ABOUT HERE

Figure 2. Taxonomy of Business Ecosystems and Disruptive Innovations



Technology Innovation

Technological innovations are made up of an increasing number of interdependent components in which the interaction between them difficult to predict (Anderson, 1999). Complementarities play an important role in technology innovation, often requiring major improvements in the complements for the technology innovation to take hold (Adner and Kapoor, 2010). Technology innovation requires multiple interactions, may be applied across multiple sectors. A recent example of this type of disruptive technology is additive manufacturing or 3D printing which originated in universities and commercial research

departments, but which is now found in sectors as diverse as aerospace manufacturing and medical devices.

The knowledge required for the development and improvement of the technology is high. Technological innovations are likely to face design challenges, as well as difficulties in the production of the final products that use it. New technologies often do not have high performance for long periods during which learning must occur. The development of new technologies involves low understanding of the technology by those industries that may ultimately be able to use it, and be disrupted by it. Businesses developing high-complexity technologies face higher risks of failure than other businesses because of greater competency demands. Alliances moderate such failure risks.

Firms seeking to bring about a disruptive innovation need to gather relevant partners who can support them to carry on successfully the disruptive innovation. In the early phase of the technology innovations knowledge come from a narrow range of sources, in particular from users, suppliers, and universities (Rothwell et al., 1974; Urban and von Hippel, 1988). In these early stages, only a few actors may have knowledge of the key technologies underlying the evolution of the product. As the technology and market mature and the network supporting innovation expands, more actors retain specialist knowledge (Laursen and Salter, 2006).

The technological innovation process is full of uncertainties and ambiguities (Narvekar and Jain, 2006), increasing the need for highly diverse teams (Carbonell and Rodriguez, 2006). Technological innovation requires ‘‘the transition from one technology path to another” (Dosi, 1982, p.161). In this context co-development structures and strategic alliances are common. As the source of value is hard to identify at the outset, a dominator firm with a visionary proposition may help to generate buy-in. Yet, the hardest stage is to convince new partners to ‘buy in’ to the innovation; once the early pioneers have confidence by participating in the innovation

development the more likely it is that other firms will be willing to join (Gawer and Cusumano, 2014). To construct and speed up disruptive innovation, early entrants should establish partnerships towards a shared vision. Firms are likely to work with competitors to share problems and carry out activities that are outside the competitor's area of interest, including basic research and establishment of standards (Tether, 2002). Moreover, streams of external funding and enhanced opportunities for academics to work on the development and improvement of new technologies could enhance incentives for new partnerships and increase the number of late entrants.

Proposition 8: *Disruptive technology innovation is more likely to take hold within a complex and open ecosystem due to the interconnectedness of components and availability of complementarities.*

Product Innovation

Product innovation can take a number of different forms.Christensen and Raynor for example suggest that disruption can come from the development of products that reduce complexity through removing expensive, but unnecessary, features allowing the innovator to focus on previously untapped market niches (Christensen and Raynor, 2003). In this case the ecosystem is likely to become smaller and more streamlined, eliminating some previously powerful players who may react hostilely. Product innovation is probably more often characterised by a multiplicity of product components to specify and produce, especially if the innovation is based on a new technology and large numbers of interactions among these components (Closs et al., 2008; Novak and Eppinger, 2012). The more interconnected are the components in a product, the more difficult it is to coordinate development (Adner and Kapoor, 2010). The level of interconnectedness in product innovation will affect the evolution of innovation (Adner and

Kapoor, 2010; Hobday, 1998). For example, a new architecture or technology about which understanding is limited. In this case the creation of a stable set of interactions between components will help to align participants in the development process whether this is within a single organisation or between multiple partners in alliance. Technologically complex products are likely to face more design challenges and greater difficulties in the manufacturing of the final product (Carbonell and Rodriguez, 2006). Products based on unknown technologies can lead to undesirable outcomes including late time-to-market, high unit-costs, and/or low product quality and functionality making value hard to achieve for collaborating ecosystem participants. The more complex and novel the product, the more important linkages with suppliers and clients are (Meyers and Athaide, 1991). The value of many products is also dependent on complementary technologies or products currently produced in other ecosystems meaning that for an innovation to become disruptive relationships have to extend beyond the current arrangements and bringing new (probably unwanted) participants into the ecosystem.

The type of business ecosystem in product innovation varies, mainly depending on the product architecture and technology. Therefore the establishment of a disruptive product innovation often varies. A disruptive product innovation, which takes place in a dynamic environment with developed legal structures may require the establishment of a complex and open ecosystem, a linear and open ecosystem, a complex and closed ecosystem or a linear and closed ecosystem. Complex products based on novel technologies will be constructed similarly with technology innovations as they both require a complex and open ecosystem. An example of this type of disruptive product is the self-driving car in which stands to impact not just it's own industry but also other industries such as regulators, city planners and Information and Communication technologies (Ansari et al., 2015). On the other hand, less complex products with relatively less

complementarities construct a relatively linear and closed ecosystem. An example of this type is raw materials such as plastics, which has disrupted other materials industries.

Proposition 9a: *Disruptive product innovation is likely to take hold within a complex and closed ecosystem when firms lack the need for complementaries and the product is complex.*

Proposition 9b: *Disruptive product innovation is likely to take hold within a complex and open ecosystem when the firm requires complementaries and the product is complex.*

Proposition 9c: *Disruptive product innovation is likely to take hold within a linear and closed ecosystem when the firm lacks the need for complementaries and the product is less complex.*

Proposition 9d: *Disruptive product innovation is likely to take hold within a linear and open ecosystem when the firm lacks the need for complementaries and the product is less complex.*

Business Model Innovation

Business model innovation is our third category of disruptive innovations. As well as being a vehicle for innovation the business model is also a subject for innovation (Zott et al., 2011). As an architecture or structure of actors or partners that work together to create and capture value the business model has systemic characteristics (Zott and Amit, 2010) and therefore does not involve a linear mechanism for value creation. Instead business models necessarily create value through an interconnected set of exchange relationships among multiple actors (Zott et al., 2011). Business model connectivity among subunits is critical for planning and executing the expansion of the ecosystem. A value network which includes firms, suppliers, partners,

community and users is critical for the disruption to take hold. Social media has provided new opportunities for user-generated content, which form the basis for innovation in the Web 2.0 era (Kaplan and Haenlein, 2010). Social media has introduced a new way for communication between users, while providing new opportunities for doing business (Wirtz et al., 2010). The community often is the locus of disruption in business model. For example, Wikileaks arises through the community of its users.

New business models are difficult for incumbents to adopt, because the business model has to fit a company's long- term strategy, corporate culture and core competencies (Amit and Zott, 2001). However, originators may have to face the competition from late entrants. Therefore, the early entrant should establish trust relationships that enhance compliance with commitments and contracts (Sanchez and Ricart, 2010).

> ***Proposition 10:*** *Disruptive business model innovation can only take hold in open ecosystems because value is created and captured based on interconnecteness firms and/or communities.*

Conclusions and Implications

Over the last two decades, extensive research has been undertaken on disruptive innovation. However, our understanding of what makes an innovation to become disruptive has been limited. Our goal in this paper was to examine how the characteristics of the ecosystem influence the process of disruption, and how the type of disruptive innovation in turn influences the characteristics and development of an ecosystem.

By bringing together the disparate bodies of research on disruptive innovations and business ecosystems, we developed a theoretical framework (Figure 1) and have drawn out the implications for the establishment of disruptive innovation through the cooption of ecosystem

participants. We contribute to theory building by examining and integrating the theoretically fragmented literature on disruptive innovation and business ecosystems. We extend the literature in three ways. First, prior studies have tried to understand the factors behind the failure of incumbent firms to respond to a disruption. Most of this research takes the perspective of the incumbent, and understanding how new entrants construct disruption has been largely neglected. In contrast we take the perspective of the disruptor - the innovation initiator, or perhaps the innovation itself, as it becomes disruptive. Second, theory on business ecosystems has been disconnected from theory on disruptive innovation. A disruption is systemic in nature and constructed in interactions with other participants in an ecosystem. A firm seeking to achieve disruptive innovation is dependent upon actions of other partners within its network to a greater or lesser extend, depending on the type of innovation. In an effort to develop a more integrated approach we highlight the argument that the structure of the business ecosystem in which an innovation is embedded can contribute to the establishment of a disruptive innovation. Therefore, instead of discussing the disruptive trends for one passive firm in its ecosystem, it is more relevant to view potential disruptors as proactive actors who can shape their business ecosystem and reconfigure its structural characteristics in a beneficial way. Third, although there is some literature that suggests that product, and business model disruptive innovations arise in different ways (Markides, 2006). This paper delineates how each type of potential disruptive innovation arises. Specifically, we believe that a typology linking the types of disruptive innovations and types of business ecosystem brings order to the theoretically fragmented literature on disruptive innovation by explaining how the type of disruptive innovation interacts with the characteristics of business ecosystems.

Taking a systemic perspective in looking at disruptive innovation, we advanced a set of propositions predicting the construction of disruptive innovations within business ecosystems

in terms of context, interconnectedness of components and complementarities, competitive dynamics and organisational forms. The propositions presented in this paper are intended to stimulate creative and strategic thinking about the evolution of disruptive innovation. The propositions lend themselves to future empirical testing. We argue that disruptive innovations are likely to take place in a dynamic environment (Propositions 1a and 1b), with developed legal structures (Propositions 2a, 2b, 3), which is characterised by high complexity and low complementarity challenges. We argue that disruptive innovation is likely to take place with the support of keystone firms (Propositions 4a and 4b) and availability of complementarities (Proposition 5). Moreover, organisational structure plays a critical role in the success of the disruption. High technological and behavioural uncertainties, which are characteristics of mainly complex ecosystems, should be reduced with incentives given by the leader of the ecosystem to fasten response to innovation opportunities (Proposition 6a and 6b). Further, we claimed that a complex business ecosystem that is relatively closed, prevents the entrance of potential competitors (Proposition 7a and 7b).

After analysing the characteristics of each business ecosystem and examining the critical factors for a successful disruptive innovation, we integrated the types of business ecosystems with disruptive innovations. We argued that disruptive technology innovation is more likely to take place in a complex and open ecosystem (Proposition 8), disruptive product innovation depending on the characteristics of the product can take in any type of business ecosystem (Proposition 9a, 9b, 9c and 9d), and business model innovation in an open ecosystem (Proposition 10).

The analyses of business ecosystem and disruptive innovation have practical implications. First, the type of business ecosystem influences the successful establishment of a potential disruptive innovation. Disruptive innovations are more likely to take hold in dynamic environment with

developed legal structures. The Government could foster a dynamic environment to support a growing economy and nurture a disruptive innovation by encouraging knowledge exchange to support innovation upgrades. The Government could set appropriate regulations for the protection of IP and contracts enhancing trust between firms. Second, potential disruptors should aim to develop innovation, which is likely to take hold in complex ecosystems with low complementarities. A linear ecosystem with many complementarities challenges is likely to fail or been taken by an incumbent or other late entrants.

Moreover, the disruptor should aim for the development of a healthy business ecosystem, which, in turn, may disrupt existing incumbents' business ecosystems. The development of a disruptive innovation will depend on the ability of the focal firm to increase the distributed diversity and productivity in the whole ecosystem (Iansiti and Levien, 2004), decreasing vertical integration and dominance. Therefore, innovators can influence the success of disruptive innovation by modifying the business ecosystem in which they operate. Multiple components in a technology or product innovation, collaborations with various partners, and share of value to partners increase the chances for success.

Although our analysis holds promise for future research, we see the need for other inquiries. First, we focused on selected constructs based on previous studies (e.g., Adner and Kapoor, 2010; Ansari et al., 2015) to develop a taxonomy of business ecosystems. While this strategy helped us to maintain conceptual clarity, we may have overlooked other types of ecosystems or characteristics. Thus, we encourage more research on a taxonomy of business ecosystems based on varous characteristics such as number of firms and the location of an ecosystem.

A second line of research would address the role of the broader national context in building of healthy business ecosystems and constructing disruptive innovations. Our discussion of the national context includes mostly the regulations that encourage collaborations between

partners. This discussion should be enriched and broadened to account for a broader range of factors shaping the disruptive innovation including universities and financial institutions such as banks and angels, and the various ways in which actors interact and shape disruptive innovations.

A third line of research would focus on the maintenance of disruptive innovation and stability of the business ecosystem. Our paper examines the construction of disruptive innovation and the building or restructure of the ecosystem. However, further research should take an ecosystem approach to examine how a present disruptor or recent incumbent reacts to the development of new business ecosystems by new entrants.

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