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Investigating Disruption

A Literature Review of Core Concepts of Disruptive Innovation Theory

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A Literature Review of Core Concepts of Disruptive Innovation Theory
by Stine Schmieg Lundgaard and Claus Rosenstand

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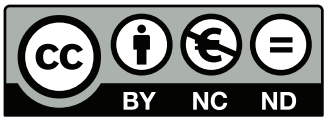

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Preface

This book shares knowledge collected from 2015 and onward within the Consortium for Digital Disruption anchored at Aalborg University (www.dd.aau.dk).

Evidenced by this publication, the field of disruptive innovation research has gone through several stages of operationalizing the theory. In recent years, researchers are increasingly looking back towards the origins of the theory in attempts to cure it from its most obvious flaws. This is especially true for the use of the theory in making predictions about future disruptions.

In order to continue to develop a valuable theory of disruption, we find it useful to first review what the theory of disruptive innovation initially was, how it has developed, and where we are now.

A cross section of disruptive innovation literature has been reviewed in order to form a general foundation from which we might better understand the changing world of innovation management in the light of disruptive innovation theory.

Introduction

In this book, we ask the following question: What are core concepts within the field of disruptive innovation theory, and how do they relate? The field of disruptive innovation has been investigated heavily, and yet the same questions are continuously being asked. We seek to clarify why that is, and what might be a valuable future direction for disruptive innovation research. Our goal is to provide a systematic overview of the development of disruptive innovation theory. As our focus is narrow, we suggest that any reader also orient himself in theory of organizational design, culture and management in order to understand the full picture of what is at play. Such a complex reality cannot be fully covered here.

"Disrupt or die!" is a direct translation of the title of a relatively recent Danish book written by Tune Hein, advisor in strategic management and transformation, and Thomas Honoré, CEO of the digital consulting company Columbus (Hein & Honoré, 2016). The message seems clear: Disruption is not only a potential threat — as sure as the Sun rising each morning, any organization will face disruptive innovations at some point.

This perspective might lead a number of organizations to think that they should drastically change whatever they are currently doing in order to take on the challenge of an unknown threat. This is paradoxical in the sense that while history continuously provides us with cases of disruption, there is no way to accurately predict such a phenomenon — both if it will happen and, if so, when it will happen. Gans (2016) has asked if an event can even be called disruptive if it can be predicted?

Uncertainty about success, failure, new markets, or existing markets is the reality for organizations, be they in the private or public domain, in the health, educational or financial sector or any other. On the diffusion of innovations, Rogers wrote in 1983 that "Uncertainty implies a lack of predictability, of structure, of information" (Rogers, 1983, p. 6). We might even travel further back and refer to Frank Knight who wrote on uncertainty that "It is a world of change in which we live, and a world of uncertainty. We live only by knowing *something* about the future; while the problems of life, or of conduct at least, arise from the fact that we know so little. This is as true of business as of other spheres of activity" (Knight, 1921, p. 199). Uncertainty as immeasurable risk has since been termed Knightian Uncertainty within the school of economics. This is to separate it from the general idea of risk, which is not necessarily immeasurable.

Herbert Simon later presented the idea that rationality of decisions is bounded by certain parameters including the cognitive limi-

tations of the person making the decision, accessible time to make it, and the degree of challenge the problem presented (Simon, 1957).

In a state of uncertainty, some organizations manage to maintain a position on top of a market while others fail. Reasons for this are probably many, and they are anchored in various cultural, societal, organizational, and personal conditions. On this matter, a question that was asked approximately 20 years ago is, to an increasing degree, being explored: "Why is success so difficult to sustain?" (Christensen, 2016, p. ix). Understanding the phenomenon of established organizations failing to sustain their success is the center of the literature reviewed in this book.

Professor at Harvard, Clayton M. Christensen, coined the term *disruptive innovation* (Christensen, 2003) in a successor to his widely acclaimed book *The Innovator's Dilemma* (2016); the book which became the offset for theory concerning this phenomenon today. We reference the updated book from 2016, but the original version of *The Innovator's Dilemma* was published in 1997. Christensen had asked himself two questions; the question quoted above regarding consistent success followed by "Is successful innovation really as unpredictable as the data suggests?". Through observations of organizations in different industries, but especially the hard drive industry, he discovered a correlation. Many organizations invested aggressively in technologies maintaining current customers' interests and, with this decision, avoided more risky technology investments in new or niche markets and customers. This decision-making process, however, becomes a competitive disadvantage if or when new technology enters the established mainstream market. (Bower & Christensen, 1995)

The terms *disruption* and *disruptive innovation* have been analyzed and described in a number of articles and books with a focus on developing Christensen's theory and suggesting methods for organizations operating in a disruptive environment. With few exceptions (e.g. Gans, 2016), these publications do not review the circumstances within which Christensen's theory was first developed as well as other theories revolving around the same problem. Joshua Gans has conducted a historical review of theory leading up to disruptive innovation. From that and a case-based study of the disruptive innovation phenomenon, he suggests yet a new way of defining disruption as "…*what a firm faces when the choices that once drove a firm's success now become those that destroy its future*" (Gans, 2016, p. 13).

Gans' thorough examination of the parallel research by Harvard professors Clayton M. Christensen and Rebecca Henderson, respectively, does not, however, encompass much other theory than

what has formed the foundation for Christensen's and Henderson's theories, missing arguments and perspectives from the large number of publications building on these as well as potentially broader lessons to learn from such a review (Gans, 2016).

Two questions are central throughout the entire list of publications: 1) how can disruptive technologies or innovations be identified and characterized?*,* and 2) what are predictive qualities of the theory? These questions can be directly related to the questions Christensen asked himself before venturing into his studies.

We see a pattern of moving back and forth between these two questions in an attempt to improve strategic methods to developing disruptive innovations as well as avoiding being disrupted.

The first question is typically examined through case studies. With historical data on incumbents that were disrupted, researchers extract essential points that led the organization to that stage. Examples of such organizations are Kodak (digital photography), IBM (low-cost PCs), and Nokia (smartphones). Patterns in the data are then used to draw models with the purpose of providing managers with control of the situation. This relates to the second question in that, inherent in these models, is an assumption that events will unfold as they have done so historically. When a model seems lacking in its predictive abilities, some researchers return to case studies to uncover anomalies to the theory and improve that foundation as well as the models based on it. Other researchers turn to related theory such as other types of innovation and develop frameworks of comparison. The question is, however: Can we use historical data this way to improve managers' capabilities in leading organizations?

In everything an organization does, there are certain boundaries within which a complex reality unfolds. In 1992, British Professor Ralph Douglas Stacey wrote that managers were beginning to develop a mindset that, in order to stay ahead of competitors, they had to "…demand general prescriptions that they can immediately convert into successful action" (Stacey, 1992, p. xi). As an example, this could include the formulation of a vision and strategic milestones to assert what Stacey calls a stable equilibrium.

Hein and Honoré, the authors behind the book cited at the beginning of this chapter, categorize Stacey as a 'guru' within a school of change management that, in their words, "…emphasizes the fact that change cannot be planned … because change happens within a complex relation between stimuli and response" (Hein & Honoré, 2016, p. 161) (Translated, Eds.). They identify two other schools of change management termed 'strategy and redesign' and 'the process of change'. With these three schools identified, they argue that, in order to be successful, managers need to take into account all

perspectives. This might be considered a rather optimistic world view based on an almost caricatured version of these fields of research.

We hypothesize that Stacey's perspective is actually central to understanding why the field of research on disruptive innovation has developed and continues to develop the way it does. Opposite Gans, we take a literature-oriented approach to clarifying the theory. A literature-oriented review has previously been carried out by Yu and Hang (2010). They characterize the theoretical field as "scattered and conflicting" (Yu & Hang, 2010, p. 435) and, from that, hypothesize that such a state might cause ambiguity in the research. While Yu and Hang's review covers a number of valuable points, we suggest that it might not be sufficient to carry out such a review in the paper form that Yu and Hang's article has been written in. Therefore, we present with this book a deeper look into the theory which might allow the reader to form his or her own opinion on the matter. For that reason, we limit ourselves to presenting thoughts on future research and not our own theoretical extensions.

On the Search for Relevant Literature

In this book, we review theory describing the phenomenon of, as termed by many, disruptive innovation. In the review, both the history of the theory as well as an overview of research optics and directions are relevant.

The pieces of literature presented here were not uncovered in one extensive literature search. When the Consortium for Digital Disruption was established in 2015 at Aalborg University, Denmark, the search had already commenced to some degree. At this point, two years later, the knowledge base present within the consortium has broadened through a number of structured literature searches as well as a more explorative process of digging into papers and books cited by central research publications as well as papers and books citing these.

We do not claim to have uncovered every piece of literature on disruptive innovation. We do, however, claim that this book presents a cross-section of essential research made on this subject. This cross-section has been built from the core works of Bower and Christensen (1995), Christensen (2016), and Gans (2016). From these tentpoles, we have collected literature that has been quoted by Christensen and Gans as well as literature quoting them. This way, the review has been formed as a result of a qualitative study on a selection criterion that the literature should be peer-reviewed. A few exceptions to this have been included — these include two interviews with Christensen (Christensen, 2001; Adams, 2016) and an article published in *The New Yorker* (Lepore, 2014).

Some sources were uncovered but not used in our review (Charitou, 2001; Christensen et al., 2002; Cravens et al., 2002; Constantinos & Markides, 2003; Picard, 2003; Christensen et al., 2004; Hacklin et al., 2004; Corso & Pellegrini, 2007). These are marked with an asterisk in the list of references. Points made in these publications are either represented elsewhere in our review or are outside the scope of our present research.

The scientific foundation for structuring this knowledge relies on the concept of research programs as defined and described by Imre Lakatos (1977). Building on Popper's falsifiability (1959) where a theory is rejected in the face of anomalies — by some, this is considered somewhat of a misinterpretation — and Kuhn's structure of science revolutions (1962), Lakatos introduce the notion of research programs. This was an attempt to solve the inherent conflict existing between the two; the general idea being that, instead of paradigms, research programs that are driven by continuously questioning currently accepted theory exist.

We have chosen to conduct a study within these frames as an acceptance of Christensen's invitation to join him in the search for anomalies (Christensen, 2016, p. xii). Christensen writes a number of times throughout the years, e.g. (Christensen, 2006), that the best way to improve a theory is to uncover anomalies — a point inspired by Kuhn. However, we cannot uncover anomalies to a theory without an overview of what the theory tells us. To this point we ask: Has the core of disruptive innovation theory changed since its first inception?

The majority of the literature presented in this book represents belts of various hypotheses and questions surrounding and challenging the core concepts of the theory. Rather than rejecting the theory in the event that it has lost its consistency to explain observed phenomena, we view disruptive innovation theory as a system upheld by specific theories and concepts that change towards a new paradigm.

The core concepts of this theory, developed and described by Clayton Christensen, is where we depart. From here, we investigate the development of the theory of disruptive innovation regarding customer orientation, technological change and competitive dynamics, organizational aspects, and information technologies; including a revisit of the definition of disruptive innovation and a ten-year status. Due to the increasing rate of publications concerned with disruptive innovation and digitization, we briefly take a look on the cross-section between these fields. Lastly, we return to the core concepts of disruption concluding with a broader historical perspective and a discussion of a main concern of the presented contributions; that is, predicting the unpredictable.

Clayton M. Christensen and Disruption

During the late 1980's and early 1990's, Christensen had studied technology development curves. More specifically, he concerned himself with S-curves characterized by an initial acceleration of product performance followed by a flattening, see Figure 1, illustrating a physical limit which requires increasingly larger engineering efforts to be employed in order to do incremental improvements. Prior to Christensen, S-curves had been used as a framework for describing how new technologies replace old but, in 1992, Christensen showed that "…the flattening of S-curves is a firm-specific, rather than uniform industry phenomenon" (Christensen, 1992a, p. 334).

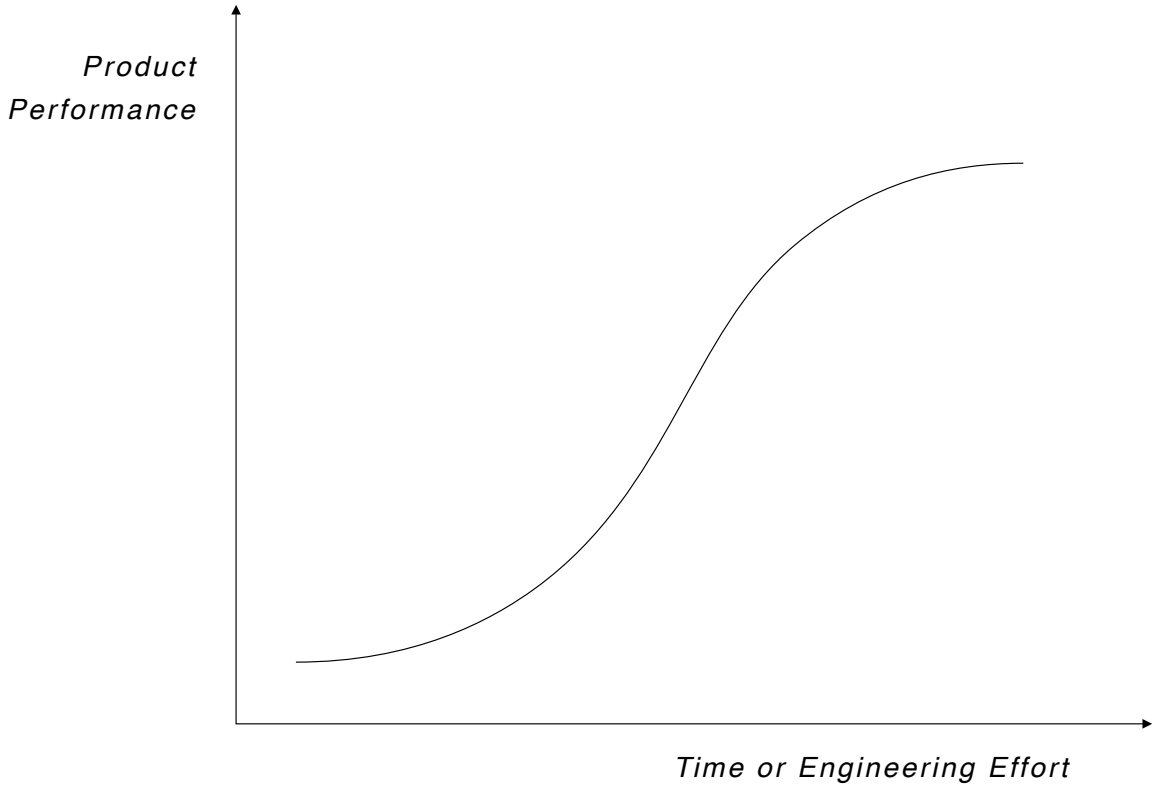

Figure 1: S-curve development. Revisualized from (Christensen, 1992, p. 335).

The second part of Christensen's study concerned itself with architectural technologies rather than component technologies. Prior to this study, the academic norm to describe architectural innovations had been through illustrations of stacking S-curves; see Figure 2.

Christensen showed that this way of visualizing the process had limited the perspective to only encompass technical aspects when in fact architectural innovations also related, to an equal or higher

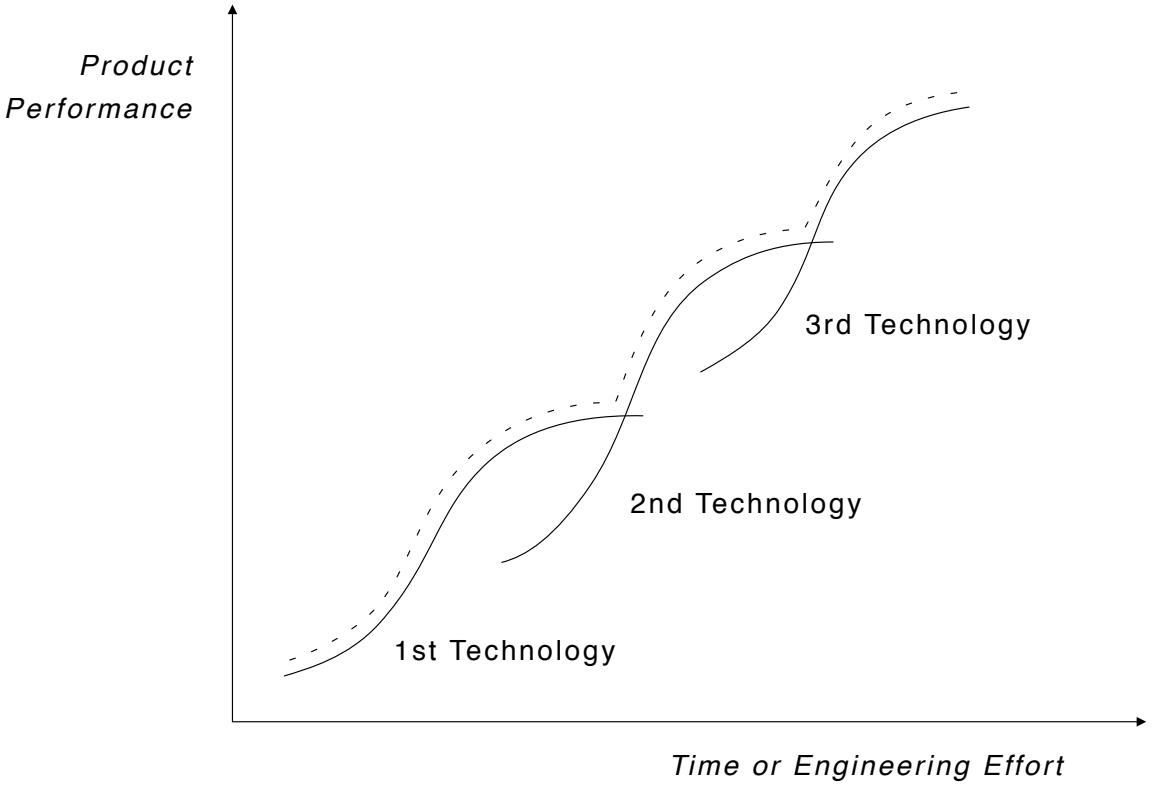

Figure 2: S-curve development. Revisualized from (Christensen, 1992, p. 335).

degree, to the market at which the innovation was aimed (Christensen, 1992a; Christensen, 1992b).

Why are these findings relevant to understanding disruption theory? Because Christensen used his findings to uncover where market entrants might have advantages over incumbent organizations already established in mainstream markets. He noted that "Attacking entrant firms evidenced a distinct disadvantage versus incumbent firms in developing and using new component technologies" (Christensen, 1992a, p. 334) while also noting that "…it is in their ability to aggressively enter emerging or remote markets that entrant firms exhibit an attacker's advantage" (Christensen, 1992b, p. 358).

Flipping the perspective in his and Joseph Bower's article "Disruptive Technologies" (1995), Christensen dove into the advantage that incumbents possess over entrants in component technology development. This advantage is based on the relationship with existing customers and a foothold in a mainstream market. Incumbents maintain that relationship and that foothold by improving their products and services on parameters those customers value.

Managing their organizations with such a strategy means that incumbents remain best (or among the best) at what initially caused them to be successful. However, at this point, Christensen had no-

ticed several examples of successful organizations failing to maintain their foothold in the mainstream market (Bower & Christensen, 1995). While many reasons for failure exist, the dilemma causing these particular organizations to fail was a dilemma of managing the organization well and still losing some or all market shares (Christensen, 2016). In fact, what would regularly be perceived as good management, i.e. incrementally improving products or services, was the cause of the failure.

These incumbents had been challenged by new organizations entering niche markets initially but later turning over profits of an amount enough to stake on the mainstream market. Characterizing what makes some entrants able to tip over incumbents who seemingly had many advantages in that competition is an essential contribution of Christensen's work since, at first sight, it might seem paradoxical that incumbents with extensive knowledge of and experience with their customers can lose their foothold.

To understand what characterizes these entrants and the situation where they are able to challenge mainstream operators, Bower and Christensen examine the hard-disk-drive industry. Throughout a period of 16 years, the physical size of disk-drives became vastly smaller while the cost per MB dropped. This development was driven both by incremental and radical advances; and not one organization managed to remain at the top of the market. Bower and Christensen discuss the concept of performance trajectories in this context as a means to explain the impact that these different innovations had on the industry. A categorization of *sustaining* and *disruptive technologies* frames that discussion.

On sustaining technologies, Bower and Christensen write that these are innovations that replace existing technologies but remain similar in the attributes that are valued by customers. Opposite to that are disruptive technologies of which the product performance attributes valued by those same customers are worse than existing products. In terms of the disk-drive industry, some manufacturers chose to sacrifice storage capacity in favor of the physical size of the disk-drives. As a result, these disk-drive manufacturers were rejected by the main computer manufacturers whose core products were equipped with disk-drives with much larger storage capacities. However, as markets for personal and portable computers developed, the need for physically smaller and lighter disk-drives arose. Incumbent manufacturers who did not risk failure by making smaller disk-drives lost market shares, or were, in other words, *disrupted*, because of that exact decision (Bower & Christensen, 1995).

On that foundation, Bower and Christensen write that opposite sustaining technologies, disruptive technologies generally "…look

financially unattractive to established companies" (Bower & Christensen, 1995, p. 47). Why would any rational organization invest in a technology promising low revenues and requiring new manufacturing structures when they have the privilege of targeting customer segments with higher profit margins with the existing infrastructure? Christensen and Bower argues that reducing the risk in new investments is exactly what innovation managers are trained to do. To them, it is a matter of securing a future career. This is known as 'the innovator's dilemma'.

The Innovator's Dilemma

The innovator's dilemma is a dilemma even good managers might find themselves in. Christensen had concerned himself not just with failing organizations but with successful organizations failing.

Christensen defines disruptive technologies as follows:

> "First, disruptive products are simpler and cheaper; they generally promise lower margins, not greater profits. Second, disruptive technologies typically are first commercialized in emerging or insignificant markets. And third, leading firms' most profitable customers generally don't want, and indeed initially can't use, products based on disruptive technologies."
>
> (Christensen, 2017, p. xxi)

It might be noted that this definition contains words such as "generally" and "typically". We hypothesize that such wording can lead to difficulties in framing what are disruptive technologies and what are not. We return to this hypothesis later in the review.

Christensen does not leave the discussion at the dilemma, though. In part two of his 1997 canonical book *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*", he seeks to show how knowledge of disruptive technologies can be used to prepare organizations for managing disruption. This was partly built on steps described in the preceding article where it is stated that "There is a method to spotting and cultivating disruptive technologies" (Christensen & Bower, 1995, p. 49).

Dissecting that statement leads to the conclusion that it is possible to 1) identify a certain set of characteristics applying only to disruptive technologies, and 2) develop potentially disruptive technologies on purpose. Christensen, however, does argue that "Experts' forecasts will always be wrong" (Christensen, 2016, p. 154) meaning that a potentially disruptive technology might not actually turn out to be disruptive. Acknowledging that disruptiveness cannot

be predicted, his methodical suggestions for innovation managers do not come with a guarantee of success. This is similar to both innovation and research in general.

Christensen's examples of organizations being disrupted had shown that knowing their customers' needs and focusing their resources on improving products in that direction was ultimately the course which led the organizations to being disrupted. For that reason, he points out that "…much of what the best executives in successful companies have learned about managing innovation is not relevant to disruptive technologies" (Christensen, 2016, p. 143). So what do they need to know in order to manage disruptive change?

Five principles are outlined to address this question. These principles regard: 1) resource dependence, 2) growth conditions, 3) failure as a step towards success, 4) organizational capabilities, and 5) a distinction between technology supply and market demand (Christensen, 2016, p. 99). A key point from Christensen is that the majority of innovations threatening an organization is of sustaining character. This means that these principles are founded in many cases, both from successful and failing organizations, in the context of disruptive innovation and, for that reason, does not justify managers abandoning their existing knowledge. "Managers of these companies simply need to recognize that these capabilities, cultures, and practices are valuable only in certain conditions" (Christensen, 2016, p. 225). While that may be, the 1997 book is concluded with a short walk-through of how to apply the principles — he does this independently of the list above, which means the principles are not necessarily obvious throughout the walk-through.

In terms of resource dependence, Christensen refers to the basis for investments as a potential barrier for discovering potential market segments. He suggests drawing trajectory maps of technologies in order to "…analyze conditions and to reveal which situation a company faces" (Christensen, 2016, p. 226). An essential distinction lies in the database for investments in sustaining innovations and in disruptive innovations.

The second principle has to do with the resource allocation process in the sense that the people deciding specifically what to prioritize are often not top executives but rather people whose intuition is based on what benefits the organization most immediately in terms of profitability. The growth conditions for the organization are strongly viewed as based on making the most profitable decisions and thereby directly eliminating potentially disruptive technologies since they initially look more unattractive. Similar to this, he points out that the challenge is related to the market an organization should target and not necessarily developing the technology. A number of cases

had shown that trying to launch a disruptive technology to current customers would result in failure due to misunderstanding the characteristics of the market segments. Initial customers for potentially disruptive technologies are, per Christensen's definition, not within the same segment as current core customers of an organization. Due to this, the framing of the challenge is crucial.

Having framed the challenge appropriately does not, however, mean that an organization is automatically able to target the new market. Often, an organization becomes increasingly specialized towards their core customer segments meaning that introducing technology to different markets could require organizational capabilities not present. This sets a threshold for the types of market and, from that, technology into which an organization is typically willing to pour resources.

Christensen wrote that failure is part of the path towards success because of the lack of information on whether or not an innovation will be well received in a market. For that reason, the processes of invention, implementation, testing, and going to market need to be inexpensive and flexible in order to lower the risk and gain information as quickly as possible. The risk also means that, more often than not, an organization should find itself switching between being a leader and a follower.

In conclusion to *The Innovator's Dilemma*, Christensen notes that the dilemma can be overcome by identifying the weak spots within an organization and creating "...a context in which each organization's market position, economic structure, developmental capabilities, and values are sufficiently aligned with the power of their customers that they assist, rather than impede, the very different work of sustaining and disruptive innovators" (Christensen, 2016, p. 228).

The impact of disruptive innovations might seem to be relatively localized to the organizations involved, but Christensen — together with Thomas Craig and Stuart Hart — presented an analysis of the Japanese economy following a period of prosperity to show that the impact can in fact be much greater (Christensen et al., 2001).

From the 1960s and 30 years forward, Japan experienced an economic boom so great that it has since been the subject for a large section of economic studies. It is no longer the case, though, that Japan is a frontrunner. Especially North America and the United Kingdom have since grown, and where their growth appears to be stable, many of the organizations responsible for the growth in Japan have not kept their levels of success.

Christensen et al. write that "Something that is disruptive in one company can have a sustaining impact on another…" (Christensen

et al., 2001, p. 94) meaning that disruption is a relative phenomenon. With this point, they argue that the technological innovations from Japan were disruptive to the organizations from Europe and America that had previously dominated certain markets, but were sustaining to organizations within their own national borders.

One example is Sony, which produced low-performing pocket radios and portable black-and-white televisions. American organizations sitting on this market had focused on improving sound and image quality to an extent that teenagers, as an example, did not care enough about. This customer segment was willing to listen to poorer sound in return for paying a lower price. Sony became successful in this market but has since moved towards other product lines such as the PlayStation game console. They are now experiencing the same challenges that the incumbents they disrupted were. The core performance of the PlayStation console is continuously being improved, placing Sony in a higher tier of the market.

The rational decisions creating those challenges leads Christensen et al. to argue that "…disruptive technologies are still more likely to come from start-up companies than from global conglomerates" (Christensen et al., 2001, p. 95). Where Sony managed to introduce a range of disruptive products over many years, other organizations such as Honda and Canon managed to do so only once.

Where places in the United States such as Silicon Valley have been the center for continuous development of disruptive innovations, Japan has, in general, experienced stagnation or decline following the successful disruptions. Japan's mature industrial structure does not cultivate a good foundation for start-ups, and employees tend to focus on climbing the corporate ladder within one large organization rather than considering the benefits of switching to a position in a new organization. Where organizations in Japan have to rely heavily on bank debt, their American competitors have more flexible investment opportunities freeing them from having to work within reasonably predictable developments. Policymakers began to reform the financial system to provide better conditions for disruptive innovations, but they have not yet created a consistent foundation, Christensen et al. argue.

In summary, disruptive innovation has had a great impact on the Japanese economy but has also left a challenge of continuing to compete with organizations from countries where other opportunities and restrictions apply. Disruption as a process conditioned by the innovator's dilemma "…could hold the key to economic development in poor countries" (Christensen et al., 2001, p. 92).

Analyzing the theory of disruptive innovation in a broader perspective leads Christensen et al. to consider more closely the con-

text of economic growth on organizational success and failure. They briefly take a glance at the concept of creative destruction developed by Joseph Schumpeter in his book *Capitalism, Socialism and Democracy* (1942). In short, Schumpeter's concept of creative destruction is a process where economic structures are revolutionized by innovations within industrial contexts — such as products and methods — destroying the old structure and creating a new (Schumpeter, 1942). Where Schumpeter's work has not been explicitly present in the majority of studies within this field, the concept of creative destruction is now beginning to appear more frequently as a part of a newer tendency to look back on the origins of the theory of disruptive innovation (e.g. Gans, 2016).

Why has such a tendency come into existence? The following part of this publication goes into the 'belt' of disruptive innovation theory in the search for an answer.

Building on the Theory of Disruptive Innovation

Even before its ten year anniversary, *The Innovator's Dilemma* had sold over 200,000 copies, underlining the popularity of the theory (Danneels, 2004, p. 246). Several researchers besides Christensen have examined and expanded his theory of disruptive innovations in efforts to both test the validity of the theory and concretize it to something applicable to managers in different industries. This part of the literature review concerns itself with these publications organized in a, mostly, chronological order.

Viewing the theoretical field on disruptive innovation as a research program, this part of the review provides an in-depth look into hypotheses put forward by an international range of researchers. While chronological, the review also includes the definition of certain themes present throughout the course of the theoretical development.

Customer Orientation

Disruption theory was and still is discussed in marketing fields due to Christensen's conclusions that customer orientation is the reason behind both organizational success and failure in disruptive business environments. Even before Christensen and Bower published their analysis, other researchers (Bennett & Cooper, 1979) had criticized the idea of customer orientation for leading only to trivial product development. However, Slater and Narver (1998) argue in a commentary paper that researchers' perceptions of customer orientation should be nuanced to understand exactly what kinds of decisions are entailed in the innovator's dilemma. They distinguish between two types of philosophies that shape the decision-making process.

Within the marketing tradition, customer needs and wants had been central to improving the performance of a business. Slater and Narver separate the process of targeting customer needs and customer wants respectively. Targeting customer wants, a customer-led philosophy, is a short-term strategy in which organizations follow expressed desires by customers through focus group studies or other types of customer surveys. They might even develop close relations to core customers to be able to monitor the development of their wants. Cited by Slater and Narver, Hamel and Prahalad had previously noted that "Customers are notoriously lacking in foresight" (Hamel & Prahalad, 1994, p. 99). They had called the phenomenon

"the tyranny of the served market", which might be seen as a predecessor to Christensen and Bower's paper the following year.

Confused with this philosophy is the market-oriented philosophy. Businesses with such a focus analyze a market in broader terms in a longer-term perspective and instead of being led by their main customers' desires, they develop products and services from knowledge about customer needs.

Technology-based innovations are often developed by market-oriented organizations that target early adopters willing to accept prototype-like stages of the technology. This group of customers is usually small compared to the size of mainstream groups in the same field. The mainstream market which Christensen and Bower had described as myopic is characterized as pragmatic by Slater and Narver since this particular group requires knowledge about how adopting the new technology into their lives will generate economic value later on. Market-oriented businesses must retain knowledge of both customer groups in order to eventually enter the mainstream market.

Slater and Narver (1998) concluded that market orientation is still essential to organizations in facing disruptive innovation. In this context, George Day (1999) argues that being market-driven has different meanings in different industries adding to the spreading confusion. While some would argue that listening to customers is an essential part of running a business, others would, as Slater and Narver also pointed out, argue that customers should be ignored. Day finds that the latter point of view has emerged from a number of misconceptions. Relevant to this review is a misconception that organizations cannot stay close to both current and potential customers.

Day explains the theory of disruptive innovation with the notion of mental models. These models "…that guide managers give known customers disproportionate attention" (Day, 1999, p. 13). Managers make decisions based on experience, but that same experience can lead them to fail to identify or to underestimate potentially disruptive technologies. This leads some to the conclusion that staying focused on existing customers' needs is a risky path. Day, however, argues that this conclusion reflects a poor understanding of what being market-driven means. Market-driven does not mean focusing only on specific segments of the total market. It also entails a "… point-of-view on how the industry structure will evolve" (Day, 1999, p. 13). This also means that organizations that are part of a value chain should understand the end-user regardless of the distance between the user and the organization in that chain.

With this, Day clears up the fact that the innovator's dilemma should not scare managers away from their current customers. He

argues that they can remain close to mainstream segments and still be aware of potential disruptions from segments with lower performance demands. Being successful does not necessarily lead to blindness towards or inability to handle potential threats. What will be apparent from more recent literature, though, is that highly aware organizations can also end up being disrupted.

Technological Change and Competitive Dynamics

While customer orientation is an explicit factor of the disruption phenomenon, another lies in the header "disruptive technologies"; more specifically, technologies. Ron Adner (2002) was among the first to build upon Christensen's theory. Adner asked the question: "When are technologies disruptive?" based on an observation that theoretical drivers of disruption were underrepresented throughout the literature at the time.

Christensen and Bower (1995) had argued that a way to identify potentially disruptive technologies was to examine the level of disagreement internally in an organization. Where marketing and finance-related employees rarely support development in disruptive technologies, they argue that technical employees often would. Therefore, this is a situation that should trigger the attention of top management.

Through what Adner terms a "demand-based view", he reviews the conditions in which disruption is enabled. At this time, the theory of disruption was still mainly focused on technological innovations as opposed to business model innovations.

Adner was not the first, however, to point out the fact that change enabled by technologies is driven by a variation of human activities. In 1976, Nathan Rosenberg wrote that "It is not possible to analyze the effects of technological change independent of the particular context within which it appears, for the availability of the same technology will exercise very different kinds of consequences in societies that differ with respect to their institutions, their values, their resource endowments, and their histories" (Rosenberg, 1976, p. 2). While not referring to disruption, Rosenberg did point out that analyses of technological change cannot be made without considering the context of that change.

In the same line of thought, Adner took into account preferences of different market segments and how these relate in order to describe the particular change that is disruption. The relationship is characterized by overlaps and symmetries between preferences. For various demand conditions, three categories of "competitive regimes" (Adner, 2002, p. 670) exist: *Isolation*, where technologies never interact; *convergence*, where different technologies are aimed

towards the same consumer segments; and *disruption*, where one technology loses its foothold with its main consumers in favor of another technology.

Adner describes consumer preferences as value trajectories and reviews the relationship between these trajectories and the three categories of emergence of competition. His findings show that as preferences overlap to an increasing degree, the development dynamics move away from competitive isolation. This is illustrated in Figure 3.

The spaces between the trajectories depicted in Figure 3 are denoted convergence, disruption, and isolation. Each represents a type of competitive dynamic created as a result of the introduction of a new product. The fixed trajectory represents an existing product. The existing product is targeted customer segments who value a certain functional attribute of a product (Y). As the new pro-

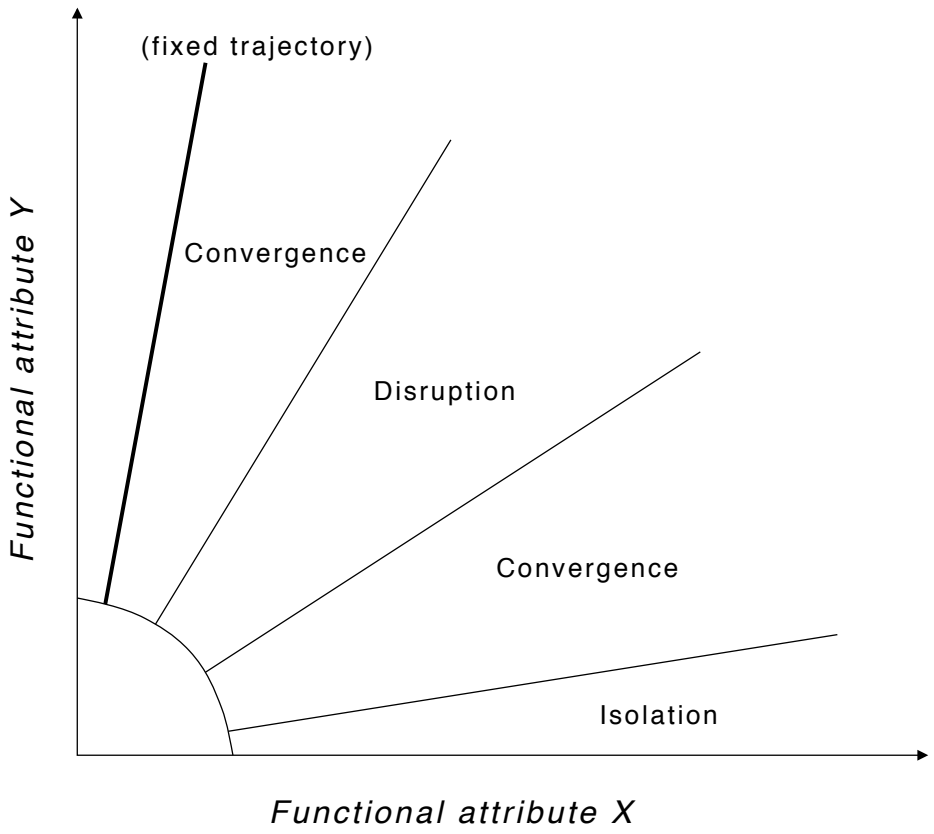

Figure 3: One value trajectory is fixed so that the relationship between two trajectories can be compared as the two trajectories grow either increasingly or decreasingly symmetrical of each other. Revisualized from (Adner, 2002, p. 678).

duct relies increasingly on another functional attribute (X), the competitive dynamics change.

When the preferences of the two customer segments are asymmetric, the environment becomes disruptive as opposed to convergent when the trajectories are symmetric. With these findings, Adner places the focus on the markets at which technologies are aimed rather than the supply-side focus which had previously dominated research in competitive strategies.

During the same year as Adner's contribution to the field, Chayutsahakij and Poggenpohl (2002) underline the importance of recognizing that an invention only becomes an innovation when the said invention is applied to a context. They write that "…innovation changes the way people live" (Chayutsahakij & Poggenpohl, 2002, p. 1). While this book does not concern itself with definitions of innovations, this particular description does put into perspective what Adner's contribution to discussion is; that is, the relevance of the demand context of the technology.

Adner continued building on his research from 2002 as well as other theoretical contributions on disruptive technologies with Peter Zemsky (2005) in a paper concerning the effect of disruptive technologies on competitive factors such as price and innovation incentives. Where others (e.g. Kostoff et al. (2004) described below) had explored initial organizational processes at this point, Adner and Zemsky (2005) explore the circumstances of disruptive technologies that have been released into a market. They do so through two research questions based on looking at the theory from an economic perspective. First, how can two technologies be in competition with each other? Second, is disruption triggered by a technological process? This question is nuanced by also considering how long it takes for the new technology to move up from the niche market. According to Adner and Zemsky, it can be hypothesized that a difference exists in disruptive technologies and technologies that never move upmarket from a foothold in a niche market. Lastly, they review competitive outcomes of disruption. The theoretical perspective lies close to the definition of disruptive technologies provided by Danneels (2004, p. 249) as something that can change the foundation for competition through a shift in competitive performance metrics. This is reviewed in the section Revisiting the Definition. In contrast, though, Adner and Zemsky examine the theory from a consumer-oriented point of view whereas Danneels focused on internal decision-making on, as an example, customer-focus.

A reason for Adner and Zemsky's specific focus is the assumption that consumers choose between technologies adjacent to each other. This assumption stems from spatial models illustrating the

markets where technologies always directly compete with each other. To accommodate this bias, Adner and Zemsky present a model through which the emergence of competition can be studied according to distinct technologies and consumer segments in a horizontal and vertical differentiation. This means that two discrete market segments are indexed according to customers' willingness to pay for an established product and a new product. With this, they show how the boundaries of a market are shaped by both the organizational behavior and customer preferences.

In relation to the first research question regarding competition between technologies, Adner and Zemsky unfold a number of factors that determine the level of threat of disruption. These include the number of entrants in the market, the size of the main consumer segment and the utility of the entrant technology of that segment, and they determine the marginal costs for entrants which, finally, determines their incentive to disrupt a mainstream market.

In terms of the second research question regarding technology as a trigger for disruption, they find that oversupply created by technology improvement due to the fact that, as performance increases, the rate of utility improvement of the established technology is reduced compared with the new technology. In relation to existing theory at the time, Adner and Zemsky show, however, that oversupply is not necessary for disruption to occur. Facets of the market structure, such as which technologies are used by organizations and to what extent they determine increase of the surplus over time.

Reviewing the competitive outcomes of disruption, their analysis shows that the profits of entrants do not necessarily increase after disrupting a mainstream market since "…their increased volumes can be more than offset by increased competition" (Adner & Zemsky, 2005, p. 231). The market becomes increasingly concentrated with competitors creating cost asymmetries.

To sum up, the detailed analysis by Adner and Zemsky show that a variety of factors impact the likelihood of a technology being disruptive — and that in some cases, a new technology might prove to be disruptive even though the trajectory of that technology is better suited to its niche market. They show that even though an organization is the niche market leader, that organization might not have an incentive for pursuing a disruptive path since the position as niche market leader can be privileged.

While Christensen and others until this point in the development of the theory considered consumer demands as fixed trajectories, Adner and Zemsky argue that both entrants and incumbents may benefit from shaping expectations that consumers have towards industries. The boundaries of competition in a given market can be

altered intentionally, though some organizations do it unintentionally by merging themselves with others. In other words, the work contributes to the definition of markets in the development of disruption theory. Previous definitions have focused on how price variations affect the competitiveness of organizations. This is, however, a static way of perceiving a market that does not incorporate the possible dynamics of future disruptive technologies.

The introduction of disruptive technologies into an existing market is also the focus of Padgett and Mulvey's (2007) structuralist study. With a departure from the technological aspects of the transformation organizations experience in such an event, they redirect the focus towards organizational processes — an approach which the studies reviewed in the following section is centered around.

When new technologies are introduced to existing service markets, both customer behavior and organizational positioning conditions change. Developing positioning strategies had not yet been covered in this context. For that reason, Padgett and Mulvey propose a method of three stages for using "...technology as a point of differentiation in a competitive market space" (Padgett & Mulvey, 2007, p. 376). They argue that organizations can use technology to change current market structures and shift the competitive advantage.

Their analysis suggests that targeting on a 'micro' level yielded better results than targeting 'macro' customer segments due to the need to demonstrate the benefits of the technology to the targeted group. It also supports Christensen's description of the innovator's dilemma since the incumbents they had examined preferred to sustain a status quo for as long as possible resulting in a long-term poor market performance as a result.

Day (1999) had described the distinction between technology-push and market-pull as a false dichotomy that some managers rely on. Excluding knowledge about the market when developing a technological innovation — and opposite — significantly lowers the chance for success. Even highly technology-driven organizations such as Hewlett Packard made sure to align their core competencies with an appropriate market strategy. Encouraging beliefs that customers do not or cannot know which functionalities in a product they want is seen in many organizations based on engineering traditions. Organizations with such values are missing the point that technological development and market developments are closely related concepts.

Organizing for Disruptive Innovation

Slater and Narver (1998) had touched upon one aspect of organizational capabilities for developing disruptive innovations. They

wrote that "…since the market-oriented business takes the long-term view, it is willing to cannibalize sales of existing products by introducing next-generation products" (Slater & Narver, 1998, p. 1004). While Christensen subtracted several general principles that organizations could apply from his case studies, some researchers have later gone into detail about how that might be carried out. This has led some studies to show that the paradox between the development of sustaining and disruptive innovations creates some challenges that might not be easily foresighted. This section provides a review of a particular set of studies within disruption theory concerned with organizational capabilities and tools.

Gilbert and Bower argue that the way a disruptive innovation is framed shapes whether an organization perceives it as a threat or an opportunity. That perception in turn shapes the strategy that the organization then employs. Christensen had also touched upon this point when he wrote that "…managers who believe they know a market's future will plan and invest very differently from those who recognize the uncertainties of a developing market" (Christensen, 2016, p. 143). Gilbert and Bower move further by recognizing that the knowledge of anticipated market developments is based on how new technology is framed internally.

Kodak is a case often studied within the field of disruptive innovation research as an example of an incumbent organization aware of its competition but ultimately failing to utilize that knowledge to its advantage. Clark Gilbert and Bower (2002) raised attention to this case in their work to further unfold organizational perspectives in avoiding disruption.

In the case of Kodak in the 1990's, managers were becoming aware of the threat from digital photography and the fact that digital photography would probably replace Kodak's core business. CEO at the time George Fisher was, in fact, so convinced of the threat that the organization invested heavily in developing new digital products for the emerging market before that market had developed clear characteristics. The products proved later to have specifications that did not fit the needs of the existing customers, and the changes necessary to accommodate those needs were too expensive to compete with organizations such as Canon and Sony (Gilbert & Bower, 2002).

Kodak's overreaction to the disruptive threat does not make Gilbert and Bower advocate only considering disruptive innovations opportunities as both framings can lead to rash decisions. The solution to the innovator's dilemma is, according to Gilbert and Bower, an issue of managing the framing of the disruptive innovation. The

result of their following analysis of disruption in the newspaper industry examples is presented as six headers on advice.

First, they had observed that, in successful cases, incumbents had separated new business units from the core organization. Separation meant that emerging technologies were no longer perceived either as threats or opportunities. The new business unit would have to be separate from responsibilities to the core organization; in some cases, Gilbert and Bower had noted that managers in new units still reported back to main offices which meant that they could not create their own work structures fitted solely to the perspective of the unit. This argument had previously been presented by Michael Porter (Porter, 1996, p. 77).

Establishing a separate venture does, however, still require funding from the main organization. Controlling that flow of funding is, according to Gilbert and Bower, essential to make the unit work completely separate from the rest of the organization. The funding should not be sized according to the level of the perceived threat to the core business. Similar to this, they discourage relocating employees from the core organization to the new unit since their thinking is heavily influenced by the perspective of that organization.

With almost complete certainty, conflicts will emerge between the new unit and the core organization. For this reason, Gilbert and Bower suggest appointing an executive already trusted by employees as an integrator who can mediate and take on both perspectives when, as an example, resources need to be divided. The possibility of conflicts is especially present when the new unit begins to successfully move towards larger market shares. In the paper, Gilbert and Bower seem to assume that integrating the unit with the main organization is the right way to go. However, in the early stages it might not be possible to know what to integrate between the unit and the main organization. Therefore, a modular approach to this can be taken.

In a scenario where the incumbent did not realize the potential of new business areas, managers can move to acquire other successful organizations. However, as will be unfolded later in this chapter, the idea that managers can successfully point to disruptive innovations and acquire the organizations behind them is very complex. Christensen argues that it goes directly against what is actually perceived as good management at such a time.

Integration has become the subject of many publications on disruption. Christensen, Matt Verlinden, and George Westerman (2002) examined competitive advantages between integrated and non-integrated firms. Specifically, the paper concerns the potential

of vertical integration; that is, when and why organizations might choose to "…develop internal capabilities to perform certain activities in-house…" (Christensen et al., 2002, p. 955); compared with horizontal stratification of organizations. They argue that vertical integration is the optimal strategy in large markets containing the most demanding customers. By contrast, over-served markets that are less demanding of performance of a particular technology seem better targeted with a horizontal or disintegrated business model. Furthermore, Christensen et al. argue that due to the fact that technologies develop at a rate faster than the customer demand curve (a core condition for disruption according to Christensen's definition), the dominant business model of a market will shift from vertically integrated to horizontally stratified in the form of specialized organizations. This process is then reversed in the case of discontinuous shifts in functionality demands due to the technological trajectory being below the demand trajectory again.

A causal sequence is outlined to show this process. Within the first step, the functionality of a technology is not to a standard expected by customers. As a result, organizations compete to improve the performance characteristics that existing customers value. Product architects then focus on building interdependent architectures because a more modular approach built on industry standards would mean that they are not at the front of the race in technological improvement — which, at this point in the process, is still essential to reaching those customer demands. Christensen et al. state that this approach entails unstructured technical dialogue. In order to minimize costs of that dialogue, an integrated business model makes sense in managing the different interdependencies.

The process where the competitive advantage shifts starts when the improvements of a technology exceed the functionality certain customers are willing to pay for. At this stage, customizable products become the highest valued by those customers, since that will allow them to strip away functionalities they perceive as unnecessary. This conditions organizations to prioritize flexibility and time to market. The modular approach enables structured technical dialogue. Cost-minimizing efforts will then result in a market dominated by specialized organizations. How new trajectories of technology improvement might develop after this stage is not a subject covered by this book.

The results are derived deductively from empirical studies previously made by Christensen himself as well as others, both directly within the area of disruption as well as related research areas. They are presented as a model of hypotheses which Christensen et al. invite researchers to test empirically. Christensen (2006) later returns

to this invitation in another contribution, which is presented further down in this review.

While Christensen presented thoughts on how to manage disruptive technological change at the time of his presentation of *The Innovator's Dilemma* and in later contributions, the challenge is continuously being explored as shown above and further along in this chapter. Considering the dilemma, many innovation managers in incumbent organizations wish to gain the competencies needed to avoid being disrupted, or possibly creating a foundation within the organization to disrupt. What are these competencies, and how do researchers communicate them in a way that enables innovation managers to use them in practice? This challenge heavily influences the literature on the subject. A small section of the literature concerns itself with the perspective of entrants while the majority views this as a challenge for incumbents. This difference in perspective (entrants versus incumbents) is a point to which we will return later. Relevant for now is the uncertainty factor that frames both the academic discussion, discussions throughout different industries, as well as this review.

The uncertainty of how to manage disruption in organizations is what led Christensen to follow up *The Innovator's Dilemma* with *The Innovator's Solution* (2003) together with Michael Raynor, researcher, director of Deloitte Services LP and, like Christensen, a Harvard graduate.

Christensen and Raynor did not write the book with the purpose of presenting a way of predicting the future, but rather unfolding the conditions within which success is achievable (Christensen & Raynor, 2003, p. 286). They compare copying the attributes of previously successful organizations in an attempt to be successful with constructing feathered wings in an attempt to fly. Because of more recent criticism of Christensen's work, it is important to take note of this point.

While Christensen and Bower describe disruptive innovation in 1995, *The Innovator's Solution* by Christensen and Raynor shifts the focus of the theory from technologies to business models and, as such, the current theoretical understanding of disruptive innovation stems from this book. Christensen had previously defined technology in a broad sense as "…the processes by which an organization transforms labor, capital, materials, and information into products and services" (Christensen, 2016, p. xiii). This definition lies close to how the concept of a business model might be unfolded which, in retrospective, might be a reason behind Christensen and Raynor's correction towards business models as a driving factor for disruption.

This leads to a framework that Christensen initially added as an extension to *The Innovator's Dilemma* but refined and expanded in *The Innovator's Solution* (Christensen, 2006, p. 43). In realizing that the capabilities leading to the success of an organization become disabilities in facing disruption, Christensen and Raynor present the framework — called RPV framework — for the purpose of assessing capabilities that might be useful in such a situation. RPV is short for "Resources, Processes, and Values", as a specification of factors impacting the business context significantly.

Besides its introduction in *The Innovator's Dilemma*, an iteration of the framework was presented in 2000 in an article by Christensen and Michael Overdorf. They had realized that the factors affecting what an organization was capable of doing had more to do with the organization itself and less to do with the technological innovation they were facing. The keyword here is transformation. Christensen and Overdorf describe the context as 'disruptive change' signifying a transition from one organizational state to another.

The amount of resources is typically what managers choose to refer to when asked: "What can this company do?" (Christensen & Overdorf, 2000, p. 2). If the organization has access to certain amounts and types of resources, they handle transformation better. While this factor is an undeniably essential part of success or failure, the processes that the organization implements in terms of project coordination, decision-making, and communication also plays a crucial part. Christensen and Overdorf argue that these processes are typically created with the intention of controlling employees' actions consistently and within certain, often rigid, procedures. Background processes such as market research habits and negotiation of budgets can especially prove to be disabilities when facing change.

This is closely related to the last factor within the framework: the values that define how new innovations are judged. Christensen and Overdorf describe values as standards to help prioritizing investments. As an organization grows, they argue, the values will become more explicit and rigid, making sure that investment priorities are directed towards the markets promising the largest amounts of profit.

As such, the factors have shifting impact throughout the organizational life cycle. Resources can be sparse when managing a start-up, but the processes and values are flexible. By contrast, incumbents experience more disabilities in terms of processes and values that become rigid, and fewer in terms of their resources. This leads to the conclusion that start-ups in general are more capable of pursuing disruptive innovations compared with incumbents. Targeting lower-profit margin markets requires a certain cost structure to accommodate them and the flexibility to make more intuitive decisions.

While the framework might be a helpful tool for innovation managers, it is also a way for Christensen to assert what he notes in *The Innovator's Solution*: the fact that "…disruption is a process and not an event" (Christensen & Raynor, 2003, p. 69). This statement is central to the literature in that it underlines the argument that disruption is more than an effect triggered by the innovator's dilemma and poorly performing products.

Christensen and Raynor go even further with this statement when they write in another chapter that "Today we can see dozens of companies making the same predictable mistakes, and the disruptors capitalizing on them" (Christensen & Raynor, 2003, p. 103). They argue that this particularly applies to markets that are new — a category of entrant markets defined and studied in this book.

Where low-end disruptive innovations "…attack the least-profitable and most over served customers at the low end of the original value network", new-market disruptive innovations "…create a new value network…" (Christensen & Raynor, 2003, p. 45). The concept of value networks is understood as a space created from the dimensions of competition and consumption that pre-occupy particular customers. Within such a framework, organizations establish competitive strategies that can also determine how they perceive new innovations.

In terms of which market to target, Christensen and Raynor argue that the heavy use of flawed customer segmentation techniques has left the focus on what customers are actually trying to accomplish untouched by many organizations. Furthermore, organizations have a tendency to base their main productivity areas on the core competencies that already exist within the organization. Tasks requiring competencies outside that core are out-sourced to suppliers. The issue, Christensen and Raynor argues, is that an organization cannot know which core competencies might be critical in a near future. They exemplify this with IBM that outsourced the operating system part of their products to Microsoft. Their core competencies lay in the design of complete computer systems; a skill for which they were widely praised. However, which one holds the larger profit margin now? The answer is Microsoft.

Christensen and Raynor argue that "…we need a circumstance-based theory to describe the mechanism by which activities become core or peripheral" (Christensen & Raynor, 2003, p. 126). The field needs such an extension as a tool to understand which decisions might end up costing the organization considerable loss of profit. They coin this as a "job-to-be-done" approach as an alternative to decision-making based on core versus non-core competencies. This approach entails a distinction between interdependence and modu-

larity. If parts of a system cannot be changed independently of each other, the system, and thereby the architecture, is interdependent. Such systems are developed in order to optimize and speed up the development process. Opposite that are modular systems where the functionality of each part is clearly specified and can be produced by outside partners. Organizations that value flexibility use this approach and sacrifice a certain amount of performance due to the limited freedom of design given to their suppliers.

The argument is that the interdependent approach serves organizations well when they need to quickly optimize their product performance, but becomes a barrier when they reach higher tiers of the market and create a performance surplus. Therefore, it is necessary to make the transition from the integrated approach to a modular approach when the demand context of the product changes. The relation between vertical integration and horizontal stratification strategies described by Christensen et al. (2002) is further developed in this respect.

A final point to take note of here can be found in the final chapter of *The Innovator's Solution* that specifically targets senior managers: "Disruptions need a longer runway before they take off to huge volumes, so you have to start them before your annual report suggests that you're leveling off" (Christensen & Raynor, 2003, p. 279). *The Innovator's Solution* presents practical considerations of how to apply the theory described in *The Innovator's Dilemma*.

Up to 2003, the strategy that incumbents might employ in disruptive innovation processes had been examined in terms of framing new technologies and integration versus separation strategies. However, an essential part of a sustainable business model, argued by Marco Iansiti, Warren McFarlan, and George Westerman (2003), is the challenge of getting the timing right. Christensen and Raynor had initiated the development of a circumstance-based theory of "Being in the Right Place at the Right Time" (2003, p. 140). Diving deeper into integration strategies, certain factors exist in determining when to (re)act to disruptive innovations. An organization might choose to act at the outset of discovering the innovation, but might also choose to wait in order to better know the viability of the technology. In that respect, Iansiti et al. build upon the points made by Gilbert and Bower (2002) – framing as well as timing become essential to whether or not an organization succeeds.

While Christensen et al. (2002) argued that integration is part of successfully shaping an organization to demand conditions in a market, Iansiti et al. (2003) focus on integration as the strategy to aim towards in opposition to separation strategies. To support this, they refer to the case of Silicon Graphics Inc. that in the 1990's,

had identified the Microsoft Windows NT operating system as a potentially disruptive threat. They created an autonomous business unit with the purpose of developing computers running NT. Separating the business units completely helped Silicon Graphics Inc. to move quickly. However, it also created serious challenges such as inefficiency, lack of customer support and delays across the entire organization. Trying to salvage the situation, Silicon Graphics Inc. chose to integrate the new business unit with the older organization. This was not entirely successful since employees left within the older organization had been disappointed by that. Furthermore, integration had never been part of the initial strategy, and for that reason the organizational competencies towards that process had not been strengthened.

Not suggesting that integration is an easy road to success, Iansiti et al. consider what might constitute success. One suggestion that had been mentioned prior to this paper by Gilbert and Bower (2002) is to appoint a mediator between each unit to "…bridge the gap between the two" (Iansiti et al., 2003, p. 60), and special attention to synergies and conflicts between the business units is precisely the core of this contribution. While an integrated strategy can be effective in terms of using existing competencies and infrastructure from the main organization, Iansiti et al. argue that wrongly targeted management attention can cause the new business unit never to reach the point of launch. An organization can, according to Iansiti et al., handle this through three different strategies they choose to call "Integrated Leader", "Integrated Follower", and "Separated-Integrated". An integrated leader strategy entails being among the first to move where the integrated follower strategy is used by organizations that would rather not take the risks that exist in being a first-mover. By contrast, the separated-integrated strategy means a phase of separation followed by an integration process. In most cases, their analysis showed an advantage for organizations choosing a strategy with no separated phase. This was especially true late in the life cycle of the new business unit since advantages of separation, such as higher levels of agility apply to earlier stages in that process. For that reason, Iansiti et al. ask the following question to organizations considering a strategy entirely based on separation: "If there's little value in leveraging your existing assets, why are you launching the venture in the first place?" (Iansiti et al., 2003, p. 62).

As such, Iansiti et al. place themselves in direct opposition to Christensen's perspective. Christensen and Overdorf had argued that the processes and values of the core organization could impede the new venture from making the appropriate resource allocation decisions. Iansiti et al. acknowledge this when they write that

“Unless managed properly, integrated efforts can stall because of conflicts between the new and the old businesses, or simply because of inertia within the organization” (Iansiti et al., 2003, p. 63). However, apparent from this quote is also that integration is the end goal of pursuing any new venture.

Like Gilbert and Bower (2002) and Iansiti et al. (2003), part of Christensen and Raynor’s thoughts went towards the idea of new or emerging markets into which organizations might attempt to expand for the purpose of beating potential disrupters. Constantinos Markides and Constantinos D. Charitou (2004) have also worked with this subject for the purpose of exploring how an organization might compete with more than one business model. A conflict of interests often exists between these business models making it difficult for organizations to manage their resources successfully. Christensen and Overdorf had argued that separate business units were necessary where targeting a new market required another cost structure, or the new market was small relative to current target markets.

Therefore, Markides and Charitou ask how “…established companies [can] embrace the new business models without diluting and destroying their existing models?” (Markides & Charitou, 2004, p. 22). The basis of this question is made on a hypothesis that Iansiti et al. (2003) were not necessarily correct when arguing that integration is an inevitable result of successfully creating spin-off business units.

An example presented in the paper is IBM that chose to launch a low-cost PC model, Ambra, in an attempt to compete against Dell’s direct selling model that was proving successful. As Markides and Charitou point out, Porter (1980) had previously argued that “…a company trying to play a differentiation and a low-cost game at the same time will find itself stuck in the middle” (Markides & Charitou, 2004, p. 23). IBM became an example of exactly that. However, other organizations have proved that dual business models can also be managed successfully. With this knowledge, Markides and Charitou show that there might be strategic characteristics to consider when operating with two or more business models at once. Additionally, they argue that different strategies for managing dual business models exist. This indicates that the previous research by Gilbert and Bower might be too broad. Markides and Charitou point out that keeping business units completely separate might lead organizations to miss out on possible synergies between them. Another perspective that existed before 2004 is the idea of ambidextrous organizations where the new business model is integrated with the main organization. This perspective favors a full integration of both

business models. Combined, existing thoughts on the subject led Markides and Charitou to develop four strategies for managing dual business models.

The four strategies are based on two axes: 1) the nature of the conflicts that might exist between the new business unit and the main organization and 2) how strategically similar the new innovation is to the existing product or service. Visualized in a diagram, the strategies can be seen in Figure 4. The two axes in the diagram are based on what previous literature has denoted as key variables in managing more than one business model simultaneously.

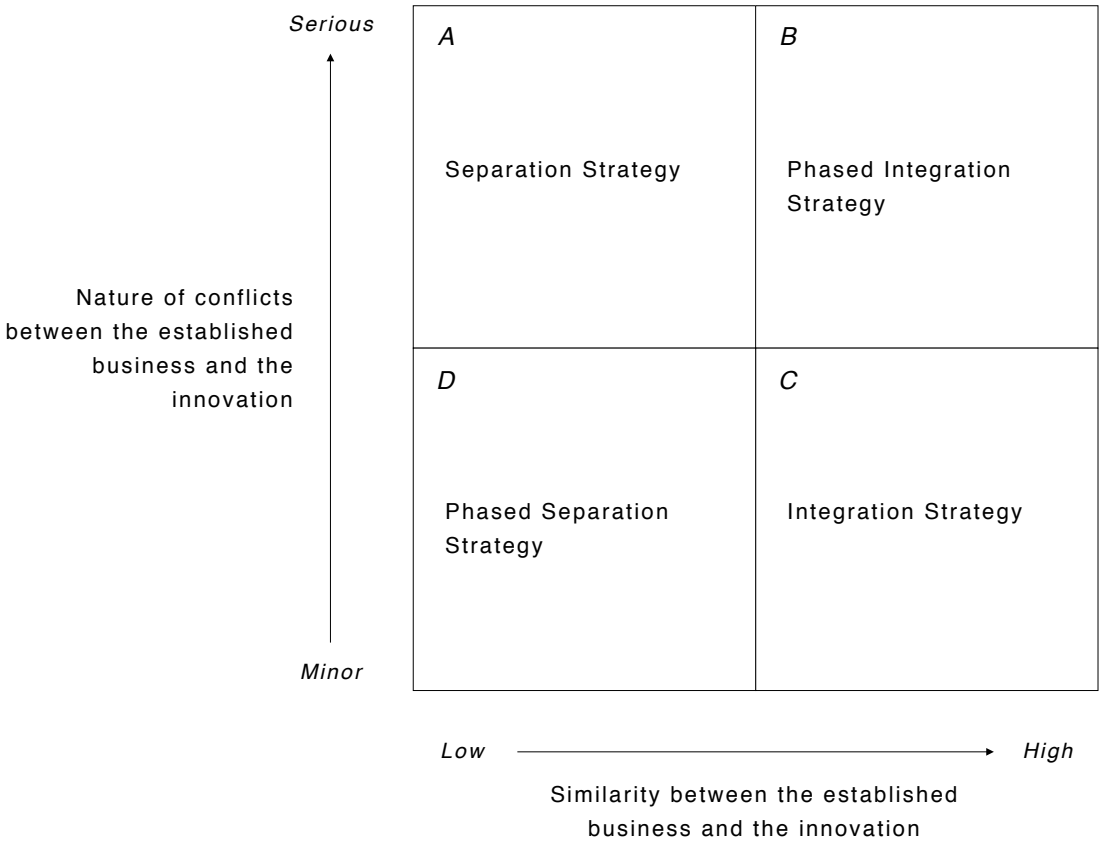

Figure 4: Four strategies for managing dual business models. Revisualized from (Markides & Charitou, 2004, p. 24).

However, deciding when to separate and when to integrate only forms part of the solution. For that reason, Markides and Charitou reviewed a number of cases and found that the performance of the organizations varied from case to case, both within each quadrant and across quadrants. A result of the analysis showed that, in most cases, when few conflicts and many similarities existed, the organizations performed well at managing more than one business model; supporting Porter's argument. Some exceptions exist, and

results from this paper suggest that in cases of many conflicts and dissimilarities, organizations might achieve better performance by providing a high degree of operational and financial autonomy to each business unit. Most important to the progress of the research, though, is the argument that a binary "do or not do" separation strategy is insufficient (Markides & Charitou, 2004).

Similar to Gilbert and Bower, Markides and Charitou argue that framing the new possibilities influences the level of success achievable by an organization. Where Gilbert and Bower argue for a leveled framing between threat and opportunity, however, Markides and Charitou argue for framing new models as opportunities when considering an integration strategy. The reason for this is that, from their analysis, "…even in the best-case scenario when an established company is *successful* in embracing the new model, the end result will be cannibalization of existing sales and much lower margins" (Markides & Charitou, 2004, p. 29). Approaching the new business model as an opportunity in the case that the new model does not conflict with the existing model gives, to a higher degree, a proactive reaction rather than a hasty one.

Erwin Danneels (2004) has later compared Markides and Charitou's conception of disruption to a distinction offered by Tushman and Anderson (1986) of competence-enhancing and competence-destroying technological shifts since Markides and Charitou consider disruption relative to the competences of organizations. Danneels also points out that Christensen and Bower drew a hard line between Tushman and Anderson's distinction and their own definition of disruption. They had observed that incumbents did not necessarily become obsolete in a competence-destroying technological shift if the technology was directed at the main customers of the organization (Danneels, 2004, pp. 248-249).

Christensen later provided the perspective that "The same innovation can be competency enhancing relative to one company and competence destroying relative to another" (Christensen, 2006, p. 48). As already mentioned, the same can be said for disruption; an innovation can be both disruptive in relation to some organizations and sustaining to others.

Even though Christensen and Raynor (2003) emphasized the fact that disruptive innovation is more than disruptive technologies, part of the academic literature still addresses disruption from a technological perspective.

Kostoff, Boylan, and Simons (2004) contribute with such a perspective in a paper concerning the identification of disruptive technologies. They define disruptive technologies as "…either a new combination of existing technologies or new technologies' applica-

tions to problem areas or new commercialization challenges … can cause major technology product paradigm shifts or create entirely new ones" (Kostoff et al., 2004, p. 142). In a similar line of thought regarding the many uncertainties of disruption, Kostoff et al. argue that technologies can only be identified as disruptive in hindsight – making them a hard case for technological forecasters. This poses a challenge for incumbents who are searching for disruptive competitors or alternatives to their current business model.

The definition is not directly based on but resembles the unfolding of disruptive technologies by Christensen, Craig and Hart (2001) predating the contribution by Kostoff et al. by a few years. Christensen et al. describe four reasons why good management can lead towards becoming disrupted. These sum up points previously made by Christensen: staying on a trajectory of sustaining innovation based on the needs of current customers, focusing on predictable technologies as well as high profit margins and, lastly, only considering large markets. From these reasons, characteristics of disruptive technologies can be inferred, such as the fact that they are inferior to technologies provided in mainstream markets.

Kostoff et al. present a process for identifying those characteristics aimed at making incumbents able to spot competitors and also develop disruptive technologies themselves.

The process is a combination of literature-based exploration and development through workshops and roadmap activities. Specifically, the process begins with defining a unique problem or opportunity for the organization in question. This would be followed by a study of relevant literature which can help uncover technology alternatives. In order to structure the process, the technologies should be prioritized. Of the high-priority technologies, the critical components to be developed should be identified. In order to develop those, expert knowledge is needed and might be put to use through workshop activities. Finally, a roadmap for developing and demonstrating the new technology alternative should be made by the experts brought into the process.

The process described by Kostoff et al. seems to relate to a context prior to the organizational challenges described in previous literature. In other words, if an organization cannot identify new potential business areas which might secure success going forward, the challenge of managing dual business models is superfluous.

Revisiting the Definition

The field of disruption theory had grown larger as interest in how to manage disruptive innovations had increased. The studies being conducted departed in *The Innovator's Dilemma* while at the same

time drifting in different directions in terms of the parts of the theory being emphasized or how the theory was interpreted. It might be speculated that this, in part, has to do with the wording in Christensen's 1997 definition of disruptive technologies as stated in the introductory chapter of this book.

Garcia and Calantone (2002) had looked at innovation typologies and terminology and found that terms such as radical, incremental and discontinuous were being used interchangeably without much consideration for how they are classified in relation to each other. They hypothesize that "...the inconsistencies in labeling and operationalizing innovations in the new product literature may have contributed to the slow progression of knowledge in these areas" (Garcia & Calantone, 2002, p. 126). What had become a tendency towards a lack of conceptual clarity in the general field of innovation studies also seemed to occur in the more narrow field of disruptive innovation studies.

For that reason, the subject of defining disruptive technologies is further unfolded by Danneels (2004) as part of identifying a number of research themes that could be *useful* to explore even further. In a sense, Danneels looks back at the core concepts of disruption theory and reevaluates the points of focus the surrounding literature could take. Danneels had observed that the specific research themes could be nuanced through research in several related fields. His contribution serves as a suggestion for further research and debate on disruptive technologies.

Like Kostoff et al., Danneels starts by asking which criteria exist for determining whether or not a technology is disruptive. A general challenge noted by Danneels in this context is the classification of different types of technologies. Another study by Chesbrough (2001) had previously revealed inconsistent terminology throughout the literature, making that classification a challenge. In other words, even if Christensen had provided clear instructions on how to classify technology as disruptive, it might not be applicable in a broader range of studies.

The themes framing Danneels' contribution are: "Definition of Disruptive Technology", "Predictive Use of the Theory of Technological Disruption", "Explaining the Success of Incumbents", "The Merits of Being Customer-Oriented under Disruptive Technological Change" and "The Merits of Creating a Spin-Off to Pursue Disruptive Technology" (Danneels, 2004, p. 248). The themes are further broken down into specific research questions unfolded in the paper.

The initial definition on which Danneels builds is formulated as: "A disruptive technology is a technology that changes the bases of competition by changing the performance metrics along which firms compete" (Danneels, 2004, p. 249). Danneels argues that tech-

nologies are disruptive when they introduce a performance metric against which existing technologies were not first measured. However, where Bower and Christensen's illustration of performance trajectories showed only one or two dimensions of performance, Danneels provides examples that show how performance often comprises several more dimensions. He argues that Adner's (2002) approach to characterizing demand-driven developments and market structures could be extended to each of these performance dimensions. Furthermore, this definition removes the factor of pricing found at an equal level to performance in Christensen's definition.

Still lacking in the body of knowledge on disruption, Danneels argues, are characteristics of disruptive technologies, arriving at his research question regarding criteria for categorizing this particular type of technology. The previous definition by Christensen had proved to be too broad since technologies that are simpler, cheaper and more convenient are not necessarily disruptive. From a practical management perspective, this poses a challenge since the theory did not consist of any explicit predictive qualities.

Christensen and Overdorf (2000) had argued that the best method for identifying disruptive technologies was to map out the trajectories of the improvement of a technology and the market demand respectively and then compare those trajectories. However, Danneels points to the lack of methods for making predictions about how future trajectories might develop. A historical research path in this direction is suggested for future work on disruption with a look at related fields in analytical technology forecasting. This should, according to Danneels, be nuanced with case studies of uncensored emerging technology samples.

The cases studied by Christensen as examples of disruption have been criticized for only being examples of success (McKenrick et al., 2000; King & Tucci, 1999, 2002; Chesbrough, 2003). However, while these critical contributions to the theory raise relevant points, they do not, according to Danneels, take into consideration the shifts in industry leadership driven by technological change. As such, it still remains uncertain when and how to determine that an incumbent has failed or succeeded in facing disruption.

Considering what makes incumbents fail, Danneels touches on a broader academic and practical discussion about whether or not incumbents have equal, better or worse conditions for radical or competence-destroying innovation compared to market entrants. This related discussion is relevant since it concerns the adaptability of organizations in technological shifts.

Whether or not incumbent organizations are more or less capable of innovation and entering new markets is outside the ana-

lytical scope of this section. It is, however, useful to note that this particular discussion relates closely to the core of many extensions to Christensen's theory; that is, the hypothesis that incumbents are inherently doing something wrong or experience an organizational inertia that inhibits the process of innovation. For that reason, we will briefly return to this later.

At the time of Danneels' paper, the theory of disruption had started to become blurred by an increasing number of non-academic discussions that did not consider the complexity of Christensen's theory (Danneels, 2004, p. 257). Within the academic arena, Danneels also argues that misconceptions about the implications of the theory exist. Christensen and Bower's (1995) conclusion that incumbents fail due to a close relationship with main customers had since been transformed to an argument against customer orientation — a perspective that cannot be found in Christensen and Bower's article. On the contrary, they argue that customer orientation was fundamental to the success of the organizations. Danneels suggests George Day (1999) as well as Stanley Slater and John Narver (1998) as examples of this. Instead of interpreting the theory that way, Danneels writes that the issue is more a question of resource allocation where focus should not be given only to current customers. He states that the cases studied by Christensen all show organizations with poor understanding of their customers' needs and product selection criteria. As a further research direction within the field of disruption, Danneels also suggests examining the conditions under which an organization might choose to create a new business unit — Danneels does not note Markides and Charitou's (2004) contribution which does fall into this area.

Ten-Year Status

In 2006, an issue on disruptive innovation was published in *The Journal of Product Innovation Management* with the purpose of contributing to the dialogue on the subject. This journal had, for more than 15 years, been the origin of "...a large proportion of significant findings regarding innovations ... with its diverse base of engineers, marketers, product managers, and R&D team members" (Garcia & Calantone, 2002, p. 111). Christensen contributed to the issue with a status on "The ongoing process of building a theory of disruption" — the title of his contribution. The chronology of the issue is followed in this review, meaning that the other contributions will be described initially and then followed by Christensen's paper in which he uses those contributions in the process of making his general argument clear.

Erwin Daneels, guest editor of the issue, initiates the dialogue with an overview of three themes of the contributions: "…1) the paradoxical role of marketing in managing across technological change; 2) the potential of organizational ambidexterity; and 3) the role of predictions from a theoretical and normative standpoint" (Daneels, 2006, p. 2). From this overview, it can be noted that challenges previously raised within the literature are still central to the research community. These include predictive qualities of the theory as well as practical management challenges when having identified a disruptive threat.

The first theme regards the fact that disruptive innovations first gain a foothold in new or existing niche markets. Targeting those markets is a challenge that organizations might disregard in favor of building technological competencies. Papers in this issue unfolding disruption theory from this particular angle address the resources needed to serve these unprecedented markets (Markides, 2006; Tellis, 2006; Govindarajan & Kopalle, 2006; Slater & Mohr, 2006; Henderson, 2006).

Also covering the second theme defined by Danneels, Henderson and Markides ask whether or not incumbents should be developing disruptive innovations — an otherwise prominent assumption in the literature that is also relevant to the final theme. Danneels argues that predictions about technologies should be kept separate from making predictions about organizations. He argues that within existing literature "…the question remains whether there are features of technology and their initial applications that signal potential disruptiveness" (Danneels, 2006, p. 3) as opposed to ex post identifiers of disruptive technologies that had previously been described.

Rebecca Henderson's paper begins the issue by backtracing disruption theory — both in terms of how the theory had developed in the eight years it had existed at the time and in terms of how the specific branch of technology management theory called *The Innovator's Dilemma* fitted into and impacted the academic arena. Christensen presented an angle on organizational failures that incumbents failed due to specific decisions in managing resources rather than technological incompetence. Lacking competencies in technology development had previously been argued to be a reason for failing to respond to discontinuous innovations — a term much less used in more recent literature but a predecessor to disruptive technologies.

Henderson suggests, however, that while Christensen had uncovered an essential part of why organizations fail, focus on the decision making process might be misleading. Literature with this focus has especially proven, in this review, to be represented in the

initial bulk of research (Slater & Narver, 1998; Day, 1999) following *The Innovator's Dilemma*. Instead, she asks if organizational routines within incumbents play a larger role than is largely acknowledged. As such, she builds on the work of Adner (2002) and Adner and Zemsky (2005) who also considered how demand conditions and technological development created disruptive environments.

The basis for misinterpretation stems, according to Henderson, from the ambivalent interpretations of the question: "Are established firms irrational in failing to respond to disruptive innovation?" (Henderson, 2006, p. 6). Henderson argues Christensen indicates different answers through *The Innovator's Dilemma* and, later, *The Innovator's Solution*. She does not, however, discuss the first article on disruptive technologies by Bower and Christensen in which they state that " Using the rational, analytical investment processes that most well-managed companies have developed, it is nearly impossible to build a cogent case for diverting resources from known customer needs in established markets to markets and customers that seem insignificant or do not yet exist" (Bower & Christensen, 1995, p. 44). While this quote does address the aspect of rationality in making decisions regarding disruptive innovation, misinterpretation of the dilemma is still happening across the literature when reading Henderson's review.

Henderson points to the fact that neoclassical literature on the subject in many regards would suggest it to be rational for incumbents to invest in the same technologies as entrants in the cases where self-cannibalization is not an immediate effect. Whether or not higher-margin projects are available to incumbents should, according to extant literature, not influence if they choose to invest in these technologies. Referring to Leonard-Barton (1992) who described the concept of competency traps in which existing competencies of an organization can become behavioral constraints on changing strategic direction, Henderson argues that the reconfiguration necessary to take on new opportunities is so extensive that the rational decision must be to refrain from making that investment. With that, the dilemma becomes more related to competency building challenges rather than a dilemma of staying too close to core customers.

The reasons behind this challenge might be cognitively or politically driven as suggested by previous literature. Maybe managers do not understand the benefits disruptive innovation could have for the organization? Maybe resources are diverted towards managers of the most profitable customer groups?

Danneels (2004) had previously noted that the theoretical discussion had become saturated with a misguided focus on turning away from main customers. He suggested that managers did not actu-

ally possess the knowledge to evaluate whether or not a technology was disruptive and, from that, he suggested a historic research path — a path Henderson took with this paper. Her findings lead her to Levinthal (1997) who suggested an analogy for organizational inertia as a localized search across bumpy landscapes. Organizations understand the landscape surrounding their own peak and build strong behavioral patterns to accommodate that area.

On that note, she concludes that Christensen's theory is a reminder of the challenge organizations face in responding to competitive shifts in a market in terms of both framing, resource allocation, and market competencies.

Following Henderson, Vijay Govindarajan and Praveen Kopalle (2006) concern themselves with the measure of disruptiveness. Where Henderson unfolded organizational challenges in handling disruption, Govindarajan and Kopalle discuss ex post studies of disruptiveness in making predictions. To do so, they initially ask how such innovations might be measured — a missing link previously pointed out by Danneels (2004). In unfolding this research question, they introduce the concept of high-end disruptions as opposed to low-end disruptions.

Govindarajan and Kopalle suggest that the relatively low level of research activity in these particular types of innovation might be due to incumbents not being able to predict them. A short review of the literature on the subject revealed five characteristics of disruptive innovations. First, the theory suggests that disruptive innovations underperform on product features valued by the core customers of an incumbent organization. Second, key features of the new product are not valued by those same customers. The third characteristic regards the price, which is lower for disruptive innovations. This is closely related to the fourth characteristic which suggests that the product is appealing to low-end segments initially lowering the profit margins. Through sustaining innovation, the new product will eventually reach a mainstream market and disrupt incumbent organizations — the fifth characteristic.

Prior to this paper, Govindarajan and Kopalle had described disruptiveness as a continuous variable defined from these characteristics. With that, they could successfully differentiate disruptive innovations and radical innovations which is a measure of how much of an innovation is based on new or existing technology. By contrast, disruptiveness can only be measured when a product has been introduced to a market. The degree of radicalism of a disruptive technology can be high or low, as pointed out previously by Danneels (2004) among others, which leads Govindarajan and Kopalle to define a category of high-end disruptive innovations. They argue

that the innovator's dilemma can be just as present with high-end innovations as with low-end innovations for four reasons. A more expensive product will be less attractive to mainstream customers, the product performs worse on features valued by these customers, it targets niche markets and the potential for profit appears low due to the small size of the market. A review of these reasons might include consideration of the difference between not targeting mainstream customers and targeting niche customers. The argument does, however, lead to a perspective on the theory of disruptive innovation based on other characteristics than low price and performance. Instead, a "…disruptive innovation introduces a different set of features, performance, and price attributes relative to the existing product" (Govindarajan & Kopalle, 2006, p. 15). As such, disruptiveness is not a foreseeable outcome, but rather a latent variable affected by organizational competencies, as discussed by Henderson (2006). This means that predicting disruption becomes a matter of identifying organizational abilities necessary to develop disruptive innovations. Behavioral characteristics such as technological opportunism and customer orientation are factors in this matter.

Measuring disruptiveness in such a way as suggested by Govindarajan and Kopalle (2006), they argue, is a more reliable method than relying on *ex ante* measures of technological performance. A number of cases exist showing that performance measures are not trustworthy. One example is McKinsey's estimate of the potential size of the cell phone market. AT&T, a telephone giant in the early 1980's, had turned to McKinsey for an analysis on the market of cellular phones at the end of the century. McKinsey concluded from extended analyses that the market would top at 900.000 when in fact that number came to represent new subscribers to cell phone services every three days (*The Economist*, 1999). They had based their predictions on linear models when in fact the development turned out to be exponential. This has also been pointed out by Ismail, Malone and Van Geest (2014, p. 26). AT&T did not invest in this emerging market until later where the market had become significantly harder to penetrate. Govindarajan and Kopalle write that this "…implies that providing the right environment for the development of disruptive innovations may depend more on long-term-oriented, subjective-based incentive plans than on short-term-oriented, formular-based incentive plans for key executives" (2006, p. 16).

Looking at the theory in broader terms, Govindarajan and Kopalle conclude that the issue of multiple business units cannot be examined without knowledge of determining the disruptiveness of innovations. Further, their definition of disruptive characteristics spe-

cifically aids in identifying potentially disruptive organizations rather than potentially disruptive technologies.

Markides (2006) continues the issue on disruptive innovation by considering Danneels' research suggestion regarding the definition of disruptive innovations. Christensen had initially formed the theory of disruptive innovation as a technological phenomenon. Later, he and Raynor had nuanced the definition to include "…such disparate things as discount department stores; low-price, point-to-point airlines; cheap, mass-market products such as power tools, copiers and motorcycles" (Markides, 2006, p. 19) which, according to Markides, are not innovation types that can or should be categorized as the same. Markides write that "Lumping all types of disruptive innovations into one category simply mixes apples with oranges, which has serious implications on how we study disruptive innovations in the future" (Markides, 2006, p. 19). For that reason, Markides unfolds two other types of disruptive innovation: Disruptive business-model innovations and disruptive product innovations.

Business-model innovation is described as discovering new business models within existing industries. One example is Amazon's entry into the book retail business in a very different way from existing players. Innovation in this instance is understood as a business model that expands an existing market to include new customers or make existing customers consume more. In this understanding of innovation lies an implication that a business-model innovation is more than a radically new strategy. Therefore, Markides and Charitou's previous case study of IBM is not an example of a business-model innovation. A business-model innovation must present an original value proposition that attract customers outside the mainstream segment — one example given by Markides is a lower price. This poses a dilemma for established organizations in that they need to establish a new value chain or value network to accommodate a new value proposition.

Considering the above, disruptive business-model innovations still fit the definition of disruptive technology innovations as given by Christensen (2016). Why, then, is Markides concerned with separating the two?

The argument here — with reference to Christensen and Raynor (2003) and Danneels (2004) — is that literature suggests that disruptive technological change is inevitable to a certain extent; a force that cannot be escaped but only navigated from. Business-model innovation does not have the same total replacement effect on a market, Markides argues. In many cases, "…the [new] business grows — usually quickly — to a certain percent of the market

but fails to completely overtake the traditional way of competing" (Markides, 2006, p. 21).

The other type of disruptive innovation unfolded by Markides is radical product innovation in which product features and value propositions disturbing existing customer behavior are introduced. Since they are rarely introduced based on expressed customer wants, they can be disruptive to both customers and producers. One might recall Slater and Narver's distinction between customer-led orientation and market-orientation in this theoretical context. Market-orientation can, to some extent, be compared with radical product innovation in the sense that an alteration of customer behavior would happen in successful cases. By contrast, the basis of the product development would either be customer analyses (Slater and Narver, 1998) or the appearance of a supply with a market potential (Markides, 2006).

Markides notes that these kinds of markets share commonalities such as a fast overabundance of entrants and product variety followed by waves of entrant deaths until the market stabilizes on the basis of a dominant product design.

Since Markides' paper, Bill Buxton has written an article on the subject of how an innovation develops through stages of invention, refinement and productization (Buxton, 2014). He calls those stages 'the long nose of innovation'. The reason for the name might be apparent from how Buxton illustrates the stages as seen in Figure 5.

Working at Microsoft, a colleague of Buxton named Butler Lampson presented the result of tracing the development of key tech-

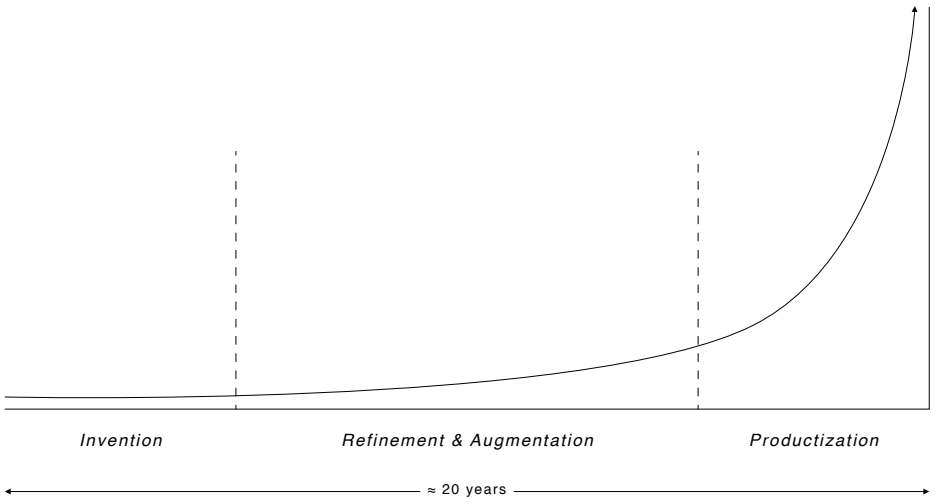

Figure 5: The long nose of innovation consists of three stages through which an innovation is invented, refined and produced. Revisualized from (Buxton, 2014).

nologies within the telecommunication and information technology sectors. Lampson's report showed that technologies consistently followed the same pattern. Around twenty years would pass from the technology's conception to its becoming a major industry.

This is a valuable point, as it highlights the fact that the invention stage does not necessarily lead towards success. The innovation process is characterized by long periods of refinement and financing. The earlier an organization enters the process, the more long-term the investments will have to be.

On this subject Christensen and Raynor also described the development of breakthrough technology as "…treacherous terrain for entrants" (2003, p. 130). These breakthrough technologies rarely fit into the interdependent product architectures developed by large organizations that are able to integrate the entire development and implementation process within one organization.

Markides argues that pioneers in this type of market are typically not the ones who become market leaders when the market matures. This is due to the fact that latecomers focus more on price and quality rather than improving the performance of the technology. According the Markides, "…the early pioneers cannot help themselves" (Markides, 2006, p. 23) and will continue to focus on the functionality of the technology which, as a result, heightens the price of the product. Iansiti et al. (2003) had previously discussed the issue of timing in support of this point.

The difference between Markides' definition of radical product innovation and disruptive technological innovation is, that in this context introducing radical product innovations to a market is better left to entrants. Incumbents would have no advantage in trying to exclude entrants from stealing the share of their customers who might be early-adopters.

With Markides' contribution to the discussion, the concept of disruption is widened to encompass a broader range of innovation types — all of which follow the pattern described by Christensen (2016) but "…produce different kinds of markets and have different managerial implications" (Markides, 2006, p. 24). He argues that defining these finer categories is essential to improving the theory.

Similarly, Slater and Jakki Mohr (2006) develop a framework with the purpose of assisting organizations to assess which strategy would be most fruitful in specific contexts. This focus stems from an interest in knowing about the ways in which an organization might be market oriented. Slater and Mohr argue that links exists between Christensen's work and the concept of crossing the chasm described by Geoffrey Moore (2002). Moore had concerned himself with analyzing challenges in targeting specific market segments and mak-

ing the transition from early adopters of a technology to mainstream customers; in short, commercialization of technologies.

Slater and Mohr ask from this theoretical perspective, how the strategy of an organization impacts the level of success in commercializing a technological innovation. In unfolding this research question, they draw insights from Miles and Snow (1978) who had presented a framework of three organizational archetypes — prospectors, defenders and analyzers — in achieving success through certain structures and processes. The hypothesis prior to the analysis is that organizations "…develop skill sets associated with success for some — but not all — types of situations commercializing technological innovations" (Slater & Mohr, 2006, p. 27). Different ways of being market-oriented determine if an organization is better suited for targeting mainstream markets by developing sustaining innovations or for using innovation techniques in developing disruptive innovations. This knowledge can then be used to point out a lack in skill sets for targeting segments outside the immediate range of an organization.

Making the transition from targeting early adopters of an innovation towards a mainstream market requires an understanding of the adoption and diffusion cycle of technologies as well as the different types of adopters throughout the cycle characterized by a broad variety of needs. In this process, organizations carry out market segmentations and market strategy definitions. This is the reason why Slater and Mohr use Miles and Snow's market strategy archetypes; they seek to uncover a match between an organizational strategy type and target market selections. Where "…prospectors seek to locate and exploit new product and market opportunities…", defenders "…attempt to seal off a portion of the total market to create a stable set of products and customers" (Slater & Mohr, 2006, p. 27). Lastly, analyzers are positioned in between. They state that previous analyses had showed that while prospector organizations maintained good rates in targeting early adopter segments, they were unsuccessful in targeting early mainstream segments.

By comparison with Christensen's theory, Slater and Mohr argue that similar characteristics exist between the market share leaders and organizational defenders and analyzers. Organizations of the defender type rest decision making processes on predictability, and analyzers are said to prefer incremental innovation to disruptive innovation. In that comparison, Slater and Mohr also build on Slater and Narver's (1998) work on market orientation which suggested a focus on emerging customer segments when developing new innovations. The fact that defenders and analyzers listen closely to their current customers potentially inhibits their ability to innovate

in new directions in the way that they operate with existing views on the market. Prospectors, on the other hand, do not operate with such constraints. Instead, they face the challenge of crossing the chasm—or shifting target markets. In conclusion, Slater and Mohr argue that success involves handling the innovator's dilemma as well as crossing the chasm. This leads them to state that proactive market competencies must be acquired when organizing as a defender or analyzer. By contrast, prospectors need to extend their knowledge about the market to encompass mainstream segments as well as developing their product to entail less risk in adopting it. They argue that this is most commonly handled by teaming up with organizations possessing the required knowledge.

Chapter 7 of *The Innovator's Solution* also departed from the opposition between entrepreneurial and incumbent skill sets. Christensen and Raynor asked which capabilities innovation managers should seek when they wish to launch a new business unit. They might choose a proven successful manager within the core organization or a successful entrepreneur from outside the walls of the organization; both options would come with certain risks. The theoretical nuances presented by Slater and Mohr might be seen as an extension to Christensen and Raynor's framework. Where Slater and Mohr focus on generalized organizational capabilities, Christensen and Raynor also focus on the impact of individual resources within top management on those capabilities.

What might be apparent from the articles in this issue until this point is that the research on the theoretical field had become highly focused on organizational competencies and skills as the determining factors in success or failure. This was mentioned by Gerard Tellis (2006) who, with a short paper, commented on the deterministic approach previous literature had taken towards examining disruptive technologies. He follows the rising agreement that disruptive technologies had been defined somewhat ambiguously within literature following *The Innovator's Dilemma*, and also picks up on Danneels' (2004) criticism that the validity of Christensen's sampling of cases can be questioned. This was not to say that Christensen's definition had been ambiguous, but it had left questions that had been dealt with in different ways, leaving various research suggestions.

Tellis refers to a previous study in which he and Ashish Sood (2005) had empirically examined technological S-curve development. Written in the first part of this publication, Christensen had examined S-curve developments prior to defining the innovator's dilemma (Christensen, 1992a; Christensen, 1992b). Tellis and Sood had concluded that the paths of technological development evidenced by their samples seemed random and did not follow the often as-

sumed replacement evolution. This conclusion does not contradict what Christensen had discovered. Rather, the main point to make with this, Tellis argues, is that S-curve theory has no predictive qualities. Furthermore, this enables Tellis to state that the general path of technological change is hard to predict. In contrast to Christensen's definition of disruptive technologies, Tellis had found that superiority of the new technology was necessarily "…price, size, convenience, or simplicity" (Tellis, 2006, p. 36). This had been true for the majority of samples in his study.

Tellis argues that due to the questionable characteristics of disruptive technologies, another reason must exist as to why some incumbents succeed and others fail, and he suggests that this has to do with leaders' abilities to create and execute visions. These leaders, he states, are willing to look beyond existing customer markets and let new business units cannibalize the core organization — essentially a combination of vision and will interspersed with variables of internal culture.

In 2002, Christensen et al. had invited researchers to empirically test their deductively derived model in order to "…continue to build deeper understanding of the circumstances under which we might expect integration and non-integration to confer competitive advantage or disadvantage" (Christensen et al., 2002, p. 957). The 2006 issue on disruptive innovation in *The Journal of Product Innovation Management* is closed by Christensen in a paper addressing what had been the results of research on and from his theory. The paper is written on a meta-level of the theory-building process framed by a model which Christensen had developed with Paul Carlile the previous year.

On the basis of an examination of research activity in various management fields, they had suggested that theory-building processes consist of a descriptive and a normative stage. These stages are completed through three steps; for the descriptive, these are observation, classification and defining relationships. See Figure 6 for Christensen's illustration of this. To support the model, Christensen writes: "It is more useful to think of the term *theory* as a body of understanding researchers build cumulatively as they iterate through each of the three steps in the descriptive and normative stages" (Christensen, 2006, p. 39).

In relation to the theory of disruption, Christensen initiated the process at the bottom of the pyramid by observing and measuring phenomena in the disk-drive industry. This led him to construct the central model of innovation trajectories based on time and performance parameters. From the construct, it became apparent, Christensen argues, that two categories of innovation existed: sustaining and disruptive. This represented the second stage of the process

from which he could finally conclude that a correlation exists between types of organizations (entrants or incumbents) and whether they would be most likely to succeed with sustaining or disruptive innovations. He refers to this correlation as the model resulting from the top step of the pyramid.

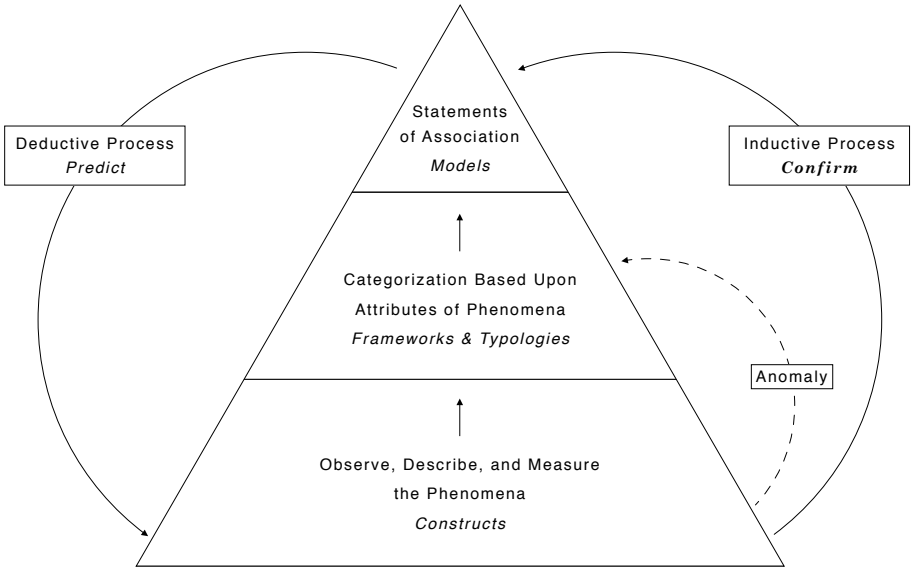

Figure 6: Descriptive theory-building process as illustrated by Christensen. Revisualized from (Christensen, 2006, p. 40).

With this understanding, we might return to Christensen's previous invitation to test the theory deductively. He argues that the way to improve the theory from this point is to climb down the pyramid by testing the hypotheses resulting from the inductive parts of the study. However, theory improvement requires some kind of anomaly to appear as a result of gathering additional data. If the theory cannot explain the newly appeared phenomenon, there is reason to return to the foundation of that theory and reconsider the elements.

Christensen writes about the theory that "…it was inductively derived, and data exists only about the past. It is not a weakness of the model; it is simply a fact of inductive theory building" (Christensen, 2006, p. 41). He argues that this does not infer that disruption can only be asserted in the event that incumbents are dethroned — a point made by both Danneels (2006) and Tellis (2006). This gives support to the predictability of the theory of which Christensen states that disruptiveness is not dependent on the outcome.

Admitting his involvement with how the theory had evolved, Christensen writes that perhaps the word disruption itself had so many prior connotations in the English language that researchers had not been able to distinguish the word from the theory. In this

publication, we have presented research which, to a large extent, confirms Christensen's observation that the academic field was still occupied with descriptive theory-building processes. While some typifications complement each other, others merely added to the rising confusion within the field.

The shift from descriptive to normative theory-building happens when concerning oneself with causality rather than correlations. Christensen argues that this happened in 1996 when he began to see that success was dependent on certain choices in the resource-allocation process. Managers typically have two ways of perceiving a new technology: either it is financially attractive relative to existing structures within the organization or not. As such, Christensen had started working on the normative side of the process which, he argues, strengthens the predictive power and thereby the usefulness of the theory. The framework that was later added in an additional chapter to *The Innovator's Dilemma* provided contingency to organizations facing disruption. Adner (2002) had contributed with normative addition to the theory when he, through mathematical modeling, introduced the concept of asymmetric competitive dynamics. This addition compounded with Christensen's framework expanded the contingency space for innovation managers.

However, the search for anomalies is still the essential element in improving the theory. Christensen mentions two approaches to this: a historical and a prediction-based. While historical data has been used as a generally accepted way to improve the theory by, for example, presenting incumbents who were able to fend off potentially disruptive competitors, the predictability of the theory is contested by many. This is evident from the parts of this review that have been presented until now. It is, though, paradoxical to a certain extent that, if an alleged potential disruptive innovation is fended off, how can we determine the inherent disruptiveness?

On those particular researchers, Christensen states that "…their fear is unfounded" (Christensen, 2006, p. 45). It is, however, to this year (2017) still a subject for discussion and therefore a point to which we will return later. For now, Christensen's argument is that predictability of a theory revolves around its ability to evaluate the phenomenon that it seeks to describe. He writes that "All that is required for a theory to be useful is to be able to interpret the meaning and future potential of a phenomenon when it is observed" (Christensen, 2006, p. 46).

In reference to Govindarajan and Kopalle's (2006) categorization of high-end disruptive innovations, Christensen moves cautiously, because the term inherently belongs to the perception of disruptive innovation as a phenomenon to be defined later.

The main focus for Christensen in this paper is to point out what he perceives as counterproductive research practice in which researchers only seek to develop frameworks and typologies that confirm the theory rather than seeking anomalies from which they would be able to improve the theory. He argues that while Tellis as well as Slater and Mohr had raised an alternative theory in the same issue, there is no way to know that his version is more qualified without determining anomalies to both theoretical concepts.

Some confusion had appeared on account of Christensen describing technologies as disruptive rather than the business model. He retracts this angle and suggests that a technology cannot inherently be disruptive — an organization can employ a technology in a disruptive business model. He had previously stated in an interview conducted by Daniel Knight from *Strategy & Leadership*'s editorial advisory board that "…technology is simply the infrastructure that facilitates a new business model" (Christensen, 2001, p. 10).

Researchers might have asked themselves whether a technology would improve beyond its competition, but then they are missing the point, Christensen argues. His plot of trajectories does not show the two trajectories as intersecting lines. They are parallel. Instead, they should be asking themselves "…whether the disruptive technology will improve to the point that it becomes good enough to be used in a given tier of the market" (Christensen, 2006, p. 50).

Size and Innovation Capabilities

The theory of disruptive innovation was initially coined from the perspective of incumbents in the sense that it originated in Christensen's question "Why is success so difficult to sustain?" (Christensen, 2016, p. ix).

Christensen and Overdorf (2000) later indicated in the description of the RPV framework that the size of an organization directly affects its capabilities of transformation. They wrote that as an organization grows larger, senior management will, to an increasing degree, "…train employees throughout the organization to make independent decisions about priorities that are consistent with the strategic direction and the business model of the company" (Christensen & Overdorf, 2000, p. 3). Strict guidelines regarding profit margins, as an example, are set to make sure that target markets can meet necessary income. This effectively removes lower-profit markets from managers' view.

Christensen then stated in 2001 that success does not mean that an organization cannot produce breakthrough innovations (Christensen, 2001). It merely means that the organization is at risk of overlooking innovations that could disrupt them. This related

to the second question he had asked himself: “Is successful innovation really as unpredictable as the data suggests?” (Christensen, 2016, p. ix).

Still, the earlier analysis had pointed to size as a factor in an organization’s capabilities to develop disruptive innovations.

Chandy and Tellis (2000) reached a similar conclusion when analyzing the assumption that more often than not, entrants are the ones introducing radically new innovations to a market. While Christensen has made sure to distinguish between radical innovation and disruptive innovation, the phenomena overlap when reading how Chandy and Tellis describe the market dynamics that result from the introduction of radical innovations. They describe the process as “…an engine of economic growth that has created entire industries and brought down giants while catapulting small firms to market leadership” (Chandy & Tellis, 2000, p. 1).

The assumption, they argue, has grown out of theories such as Christensen’s, as well as studies that had either been too local geographically speaking or too narrow in terms of the scope of products involved. This fallacy was later noted by Henderson (2006) among others, but rather than looking for other reasons behind incumbent failure, Chandy and Tellis carry out a cross-sector analysis to uncover the percentage of radical innovations coming from incumbents versus entrants as well as how the size of the organizations impacts those numbers. An incumbent in this context is described as “…a firm that manufactured and sold products belonging to the product generation that preceded the radical product innovation” (Chandy & Tellis, 2000, p. 2).

Radical innovation, they argue, follows an S-curve development with new innovations being initially inferior to the benefits of current innovations. At some point in the process, the new innovation surpasses the current in terms of the benefits it offers to customers, making its development curve flatten as a result of decreasing investment of time and resources. Chandy and Tellis argue that the concept of what they term ‘the incumbent’s curse’ partially stems from a theory of organization inertia; that is, an organization has optimized its processes for serving current customers, and employees with skills for that would not be motivate them to drive the necessary changes.

Through a historical analysis, they wish to clarify whether this and other arguments for the assumption are valid. The analysis is based on more than 250 books and 500 articles. While the study revolves around radical innovation, the results are also interesting to the field of disruptive innovation.

Chandy and Tellis point out that, especially since World War II, a considerable number of incumbents have shown a willingness

to cannibalize themselves. Since they also found examples of the opposite case, they attempt to point to some of the factors making a difference. These include organizations having the decentralized climate of a start-up as well as a high level of technological awareness and knowledge. They argue that the cases in which an entrant manages to overtake the position as market leader from an incumbent "…are likely to be more eye-catching than are those in which the mighty remain mighty" (Chandy & Tellis, 2000, p. 14).

In *The Innovator's Solution*, published three years later, Christensen and Raynor made a similar point. They argued that instead of viewing the challenge as a matter of transforming core competencies, it is a matter of knowing when to develop an interdependent system and when to outsource and take on a more modular approach.

It can be concluded from this that some of the assumptions made about incumbents might not always be true. King and Tucci contributed with a paper in 2002 outlining academic suggestions about how incumbents enter new markets. Where some researchers suggest that general experience with entering markets builds necessary capabilities to continue to do so, others debate the importance of the role of managers. Experience seems to be a core element to these studies, but there was no agreement in terms of the kind of experience necessary to take on that specific challenge.

Experience is often correlated with routines. Whether or not these routines are the source of organizational inertia — such as the studies reviewed by Chandy and Tellis (2000) suggested — or they help the organization is not clear. The keyword for King and Tucci is dynamic capability as a term partially responsible for the "…ability [of an organization] to respond to a new market" (King and Tucci, 2002, p. 172).

Through a study of the disk drive industry, King and Tucci show that experience does not necessarily lead to organizational inertia. Further, they did not find evidence to support the idea that experience in transformation affects the market entry. Experience does, however, have an effect in terms of recognizing potential value in new markets. Managers with experience of improving existing structures and strategies in an organization create a better foundation for sales in new niche markets. They conclude from this that managers are motivated to enter new market niches if their experience has given them an advantage for doing so.

King and Tucci acknowledge that the disk drive industry has had very short stable periods that might have prevented organizational inertia to really manifest itself. Christensen and Bower's (1995) stated that inertia had been the reason why some organizations

in that industry were slow to initiate the internal development processes for targeting the new markets. King and Tucci, however, argue that experience actually allows organizations to achieve better results. This does not, however, mean that the experience is automatically utilized.

As an indirect extension and contrast to King and Tucci's study, Garrison (2009) showed that while large incumbents are generally more capable of detecting potential disruptive innovations compared with small organizations, they seem less capable of responding to it. An important note to make here is that Garrison defines disruptive technology as "a radically new scientific discovery" and its counterpart, sustaining technologies, as "technologies that offer incremental improvements over technologies already in existence" (Garrison, 2009, p. 444). In this definition lies the assumption that the value and use of disruptive technologies is harder to understand.

Disruption and Information Technologies

Briefly touched upon throughout the literature up to the present decade is disruption in the domain of information technology. "From digital identity to Wi-Fi, these technologies promise to make waves" (Schwartz, 2003, p. 1). An inherent point from many of these studies seems to be that digital technologies are going to disrupt analogue technologies due to factors such as the speed at which the performance of these technologies can be developed.

George Erber (2004) and Hüsig et al. (2005) studied the broadband communication industry, and how players in that industry might be disrupted. Erber argued that the music industry was an example of an industry that had become subject to a number of disruptions. Before data streams such as audio and video became digitized, a varied number of organizations could coexist. They each specialized in product categories such as video recording or record playing. When the CD and DVD arrived, different types of data could be both stored on, and played from the same unit. A new technological paradigm in data storage meant a convergence of what had been separate industries into one universal industry.

The telecommunication industry displayed a similar organizational environment where fixed line services and wireless networks were perceived as complementary to each other. Erber points out that while mobile phones had earned significant market shares worldwide, fixed line services were not decreasing. He speculated about whether or not that market division would continue.

In this context, Adner's (2002) work on market symmetry and asymmetry is relevant to think back on since he clarified how some products and services could coexist in an industry; cf. the section

Technological Change and Competitive Dynamics. With the possibility to transmit data digitally via Internet Protocols, a universal communication tool began to form, converging previously separated markets. Further, since the need for fast transmission is high, bandwidth has been an essential factor of different transmission services. When the computer entered the business fields, organizations required only local area network (LAN) solutions, but as fast information flow is becoming an increasingly important part of running an organization, large international organizations are requiring wide area network (WAN) solutions that are able to connect different departments at different locations.

However, telecommunication network providers who had been relying on fixed line services were reluctant to replace their copper network with wireless solutions since such a shift would mean large investments and thereby higher prices for customers. It made more sense to invest in cable-based solutions such as ADSL to ensure a gradual transition which the established organizations could follow. Erber describes this decision-making process as a result of reduced costs. The organizations had invested a significant amount in the technologies around which their business was built, and those investments could not be recovered.

According to Erber, this left the telecommunication industry in danger of being disrupted by IT organizations able to offer higher bandwidth connections since they were not constrained by a fear of self-cannibalization, and reliant on customers' willingness to pay monthly fees to both telephone and internet service providers. Looking back, 13 years later, it seems he had a valid point.

Hüsig, Hipp, and Dowling (2005) were, like Erber and other researchers at the time, interested in the prediction that wireless LANs would be disruptive for incumbents in the telecommunication industry. However, their method and subsequent analysis indicated that contrary to Erber's belief, W-LAN technologies would not be disruptive to established organizations. They stated that one of the weak spots of the theory, also believed by others, was its usefulness in making predictions. The theory had been oversimplified by some to focus only narrowly on core customers. As described above, Henderson (2006) later provided a more thorough clarification of this issue in developing the theory with her focus on the importance of competencies within organizations. Therefore, Hüsig et al. developed a method of analyzing emergent technologies with the intent of uncovering disruptive characteristics based on Christensen's theory (2016) and Adner's (2002) complementary research. The purpose of the method is to determine the level of disruptive threat a new technology poses.

From a literature review, they identify seven characteristics of disruptive technologies: 1) Initial low price, 2) performance oversupply, 3) rejection by mainstream market, 4) promising relatively low profit margins, 5) success in niche or new markets, 6) asymmetric preference trajectories, and 7) an intersection between the disruptive trajectory and the trajectory of performance demand (Hüsig et al. 2005, p. 21-22). In order to compensate for the differing views of market and technology, they suggest that forecasting from these characteristics should be carried out by a team of industry experts as well as technical publications.

Hüsig et al. utilize the method in an analysis of the telecommunications industry for the purpose of clarifying whether or not W-LAN will be disruptive to incumbents. Within this industry, they distinguish between two services; voice and data communication. For voice communication services, coverage and quality are core attributes valued by customers. Since the technology used for these services has reached a stage where the quality exceeds customer demands, price has become the basis for competition. Hüsig et al. argue that, while this "…could be an indication of performance oversupply … the mobile voice services are still inferior to the fixed line phone services concerning the quality of voice transmission" (2005, p. 23). For data communication services, bandwidth is an essential attribute when it comes to Internet access, but in relation to information communication, richness and mobility are more valued than bandwidth.

The technical publications used in their analysis were provided by Vodafone, a British telecommunications organization. From those factual documents, it was evidenced that W-LAN was not an inferior technology in terms of bandwidth, but was in terms of mobility and security. Furthermore, the niche areas in which W-LAN was used were in fact the most profitable segments of the market.

While Hüsig et al. acknowledge that the reliability of the method relies heavily on the information provided, they argue that they can predict that W-LAN will not be disruptive to telecommunications incumbents as it does not fulfill the characteristics identified for disruptive technologies.

The broadband communication industry certainly seems to be an interesting case in the context of disruption but, more recently several scholars have concerned themselves with similar studies for other information-based technologies.

The studies focusing on specific technologies so far reviewed in this book have revolved around single technologies; studying how a single technology might impact an industry. Like researchers before them, Rao, Angelov and Nov (2006) were also interest-

ed in the telecommunications industry. They conducted a study on Skype with the purpose of developing knowledge about cases where more than one disruptive technology are included. Skype is an example of an organization fusing two technologies, peer-to-peer computing (P2P) and voice-over-Internet-protocol (VoIP), into one model.

The basis for Skype's P2P system was the connection of network nodes to ensure that no implementation or maintenance was needed centrally. The resources were in that sense distributed, and the solution became scalable. Both P2P and VoIP "…introduced new performance criteria in certain niche market settings" (Rao et al., 2006, p. 181), and both technologies were slowly moving towards mainstream markets and thus followed a disruptive trajectory.

Rao et al. argue that the combination of these technologies created a discontinuous innovation; an innovation that brings with it a technological breakthrough or a new delivery paradigm. This means that a new market value is asserted, and resources might be distributed differently than before because of a shift in performance metrics to be met.

Like Gilbert and Bower (2002), Lucas and Goh (2009) analyzed the case of Kodak and digital photography. Where Gilbert and Bower had focused on Kodak's framing of a disruptive threat, Lucas and Goh look more into the transformational process Kodak needed to go through from an analogue to a digital product.

Customer behavior changed with the introduction of digital cameras. Instead of waiting for carefully taken photos to be developed, customers can take a large number of photos at no additional cost and delete whichever photographs they do not like.

When the market value of a product category changes, Lucas and Goh argue that a change within all levels of an organization targeting that market also needs to change. Main responsibility for that change lies with senior management who will need to drive the necessary internal motivation. This focus resembles King and Tucci's contribution where transformation processes are reliant on the dynamic capabilities of an organization. Lucas and Goh look into management propensities as a determining factor in how a response is formed based on dynamic capabilities and rigidities. This, coupled with the culture of an organization is the scope of their study.

When Kodak was initially founded in 1880, a core source of revenue was the film used in their cameras. They had no need to make the cameras expensive, because customers would need to continuously buy film. The quality of their film became their main focus, and, for that reason, they brought in managers with a background in the manufacturing processes behind that core product.

Gilbert and Bower argued that Kodak's failure to enter the market for digital photography had been due to hastened decisions and, not being able to learn which attributes customers would value in digital cameras. When Kodak had experienced tough competitive pressure for more than ten years, they brought in George Fisher in 1993, also noted by Gilbert and Bower. Lucas and Goh explain that the board perceived Fisher as a "digital man" (Lucas & Goh, 2009, p. 49).

To this, Lucas and Goh state that the case of Kodak shows an extension to Christensen's theory. Where disruptive technologies had been defined as products that were typically cheaper and performed worse on valued attributes, digital photography also posed a specific challenge to Kodak in the customer behavior and distribution changes it created. While Kodak had dynamic capabilities necessary for transformation, the rigidities in the organization, especially within middle management, meant that they could not steer away from producing film. While Fisher was seen as a digital man, he did not manage to change the culture of other managers than the board itself.

During Fisher's time, Kodak maintained its focus on the core consumable, film, and managed to lower the production costs significantly in his time as CEO. When the value of digital cameras sold eventually surpassed the value of film cameras in 2000, Fisher left Kodak. At this point, with Daniel Carp at the helm, Kodak began its digital transformation even though the organization had begun investing in digital products as early as during the 1980s. It was not until then that a culture was established that physical consumables could not secure the future of Kodak.

Concerned with technological change as an interdisciplinary subject, Menon (2011) opens the perspective to two fields of study, business economics and Internet studies (Menon, 2011, p. 348), suggesting a dialectical relationship between Christensen's theory and the analytical frameworks of generativity developed by Jonathan Zittrain (2008). Zittrain explains generativity as the capacity of technology "…to produce unprompted change driven by large, varied, and uncoordinated audiences" (2006, p. 1980). The purpose with Menon's study is to nuance the discourse within both disruption and Internet generativity studies by unfolding complementary traits specifically to contribute to the field of ICT. One aspect of this is asset specificity.

If a product is improved based on specifications regarding, for examples, location or human assets, it becomes less generative. This in turn typically makes the organization increasingly vertically integrated. Some devices such as PCs "…are designed to be void

of asset specificity, due to the separation of hardware from software" (Menon, 2011, p. 352).

To discuss the relationship between generativity and disruptive innovations, Menon draws on a theory of complementarities by Milgrom and Roberts (1995). In short, the theory is that the practices of two organizations are more valuable together than separately. An essential aspect of conducting that change is coordination between the two. Menon argues that the theory can be transferred to extract core concepts of the two theories, which can then be used to complement the discourse within both fields. He argues that it is increasingly difficult for scholars to use studies outside their specific niche fields, causing a kind of fragmentation of knowledge.

Through his analysis, Menon finds that the approaches in his study share a commonality in terms of a transaction cost scope. In cases of low asset specificity, a market network becomes the norm. Organizations become interconnected nodes in a horizontal network; thus, the cost of coordination increases.

Throughout these publications, a hypothesis exists that information technology demands a special disruptive innovation theory. This topic has more recently been unfolded by Baiyere and Salmela (2013) who propose a specific research agenda on the relevance of information technology in the development of disruptive innovation theory. A similar statement was made by Sultan (2013) who argues that the dynamics of innovation management have changed with the introduction of information and communication technologies.

The Digital Disruption

One might wonder about the increasing rate of publications concerned with the subject of disruptive innovation and digitization. In 1999, Isenberg called the Internet the 'mother of all disruptions' (Isenberg, 1999). He might be considered a predecessor to a trend that has now formed where researchers and management consultants concern themselves with digital technologies as a case of disruptive innovation. Michael Latzer (2009) later wrote that some parts of the literature were beginning to question if the radicalness of digital technologies is what confuses the authors behind such studies. We will return to Latzer's comment on this trend at the end of this chapter.

A study conducted by Innosight in 2012 showed that the period in which organizations remained on the S&P 500 list had shrunk from 61 years in 1958 to 18 years. This study was led by Richard Foster, Director and Senior Partner with McKinsey & Company for more than 20 years, who wrote the book *Creative Destruction: Why Companies that Are Built to Last Underperform the Market – and How to Successfully Transform Them* (Foster & Kaplan, 2001). Returning to the concept of creative destruction in a later section, the pace at which the life span has changed certainly lends itself to question how the context within which organizations operate has changed.

Using the term "disruption" as an expression of societal transformation based on the development of digital technologies, Eric Schmidt, CEO of Google at the time, and Jared Cohen, Director of Google Ideas (now called Jigsaw), writes about what they term "The Digital Disruption" (Schmidt & Cohen, 2010). While they focus on the effects of digitization on governmental power, the paper also points to organizational impacts. They write that "Companies whose products or services revolve around information technology … deal in a commodity that is inherently political" (Schmidt & Cohen, 2010, p. 84). The information handled by these organizations, whether they provide Internet platforms or construct mobile phones, is relevant in a political sphere. As such, organizations in the digital domain are jointly building an interconnected estate, allowing people from different backgrounds to speak up.

The word "disruption" gains a broader meaning with Schmidt and Cohen's paper and, like Christensen et al.'s (2001) paper on the Japanese economy, shows the levels at which the disruption phenomenon can be considered. By contrast to Christensen et al. (2001), however, Schmidt and Cohen do not concern themselves with how single technologies impact a market, but rather a category of technologies: digital technologies.

In 2010, "…more than 50 percent of the world's population has access to some combination of cell phones …]and the Internet" (Schmidt & Cohen, 2010, p. 75). Where Schmidt and Cohen consider the consequences of such statistics in a political context, it might be wondered how organizations are also affected. Erber had written previously that "…a new technological trajectory also leads to a new kind of industry with different key players and new industry structures" (2004, p. 18).

While digital technology offers new opportunities and challenges in political, social, and organizational contexts, Downes (2009) points out that society is not necessarily capable of harnessing those opportunities. He describes what he calls a principle of modern life: "*technology changes exponentially, but social, economic, and legal systems change incrementally*" (Downes, 2009, p. 2) referring to Kuhn's paradigm shifts and Schumpeter's creative destruction; i.e. a replacement process. He states that this process is a law of disruption; also the title of his book. It might be questioned why Downes chooses to consider disruptions as technological breakthroughs as Christensen had previously emphasized the difference between disruptive and radical innovations. As Downes is not, like Schmidt and Cohen, considering technology in a broader sense, this seems to miss Christensen's point. Disruption in Downes' study shares more commonalities with its dictionary origins; i.e. a disturbance or something that interrupts (*Oxford Dictionaries*, n.d.), than the theory of disruptive innovation.

It might be useful to consider Bell's Law in this context as an explanation for Downes' perceived relation between disruptive innovations and digital technologies. In 1972, Gordon Bell described four classes of computers where each new class has brought with it new markets. As the price for physical computer technology decreased, the user groups expanded, making system design costs rise in accordance with a need for reliable and maintainable products.

While Gordon Moore stated that around every 18th month, engineers are able to double the numbers of transistors in an electrical circuit (Moore, 1965), Bell argued that the components used for each computer class actually had a decrease in transistors and were sold at lower prices. The time it takes to develop a new class is also the time it takes to understand how the new class will evolve and potentially disrupt the previous class.

Digital technology is the exact focus of a number of authors such as Downes who couple disruptive innovation theory with the context of digitization. Another example is the book by McQuivey and Bernoff with the title *Digital Disruption: Unleashing the Next Wave of Innovation* (McQuivey & Bernoff, 2013). These books are typically

initiated with an introduction painting a picture of a world in dramatic change caused by an increase in technological innovations and the pace at which they are developed. McQuivey and Bernoff use the case of the then 12-year-old Thomas Suarez whose TEDx talk received more than two million views. Of his generation, they write: "…they have the right mindset; one that compels them to use these tools in *disruptive* ways. They are the next step in the evolution toward a digitally disruptive economy" (McQuivey & Bernoff, 2013, p. 6). Thomas had developed an application using Apple's software development kit which, while not successful in a general sense, represented the fact that people have the opportunity to implement their ideas relatively quickly and easily.

While this might be true, McQuivey and Bernoff seem to make a mistake similar to Downes when they write that "Equipped with a better mindset and better tools, thousands of these disruptors are ready to do better whatever it is that your company does" (McQuivey & Bernoff, 2013, p. 7). According to Christensen, sticking with what your organization does best in developing products or services is sustaining innovation. Disruptive entrants are not competing with incumbents on their core competences — that would most likely lead them towards failure.

McQuivey and Bernoff do, though, make a point that relates closely to Christensen and Raynor's concept of jobs-to-be-done when they write that "…disruption means finding a better way to meet a *fundamental need* that the customer has, not just replacing an existing process or outcome with something similar but slightly better" (McQuivey & Bernoff, 2013, p. 8). The relation to digital technologies in terms of this is not, however, clear.

Whether considering the effects of digitization on a political, organizational, or individual level, many digital technologies will replace older technologies. That replacement process is not necessarily disruptive as suggested in a large part of the literature. Looking at digital technologies in general from Schmidt and Cohen's perspective, they certainly do follow Christensen's theory as well as Buxton's model on the "Long Nose of Innovation" in how society is becoming increasing digital. However, zooming into individual technologies, reality is more complex. Some digital technologies are sustaining innovations, and some are disruptive. The fact that the pace at which these technologies are developed is increasing at the present moment does not change the fundamental model of disruptive innovation.

On literature concerned with disruptive innovation in the coupling of Internet-based and wireless technologies, Latzer wrote that "… these classifications and assessments not only differ in detail but

are even contradictory" (2009, p. 599). He argues that Christensen's theory is not directly applicable to the sector in general and that many researchers make the mistake of generalizing from single cases. Garcia and Calantone made a similar statement in their literature review from 2002 on innovation typologies.

Assessing the impact of different digital technologies has proved, both for broadband communication and Internet-based technologies, to be a hard task.

The background for this statement can be found in Latzer's walkthrough of innovation typologies and review of the position of disruptive and sustaining innovations in relation to previous typologies. He argues that the definitions of sustaining and disruptive innovations builds on the dichotomy between radical and incremental innovations — though definitely not being equal to that dichotomy. The difference between radical and incremental innovations is the intensity of technological change they each represent. Furthermore, incremental innovations are often associated with existing technologies where radical innovations are typically associated with technologies that impact incumbents in a market negatively.

Core Concepts of Disruption

"…disruption theory is in danger of becoming a victim of its own success", Christensen wrote in 2015 together with Raynor and McDonald. Looking back on the 20 years of theoretical development since the article "Disruptive Technologies: Catching the Wave", by Christensen and Bower was first published, many organizations, start-ups, and researchers have joined and attempted to contribute to the landslide of the theory.

Along the way, Christensen has contributed with input mostly for the purpose of setting the record straight on how the theoretical development should be carried out. Arguably, the theory has been the subject of discussion on several parameters. This includes its data foundation, its ability to precisely describe the phenomenon and its usefulness in making predictions.

One example of a critic of the theory is Jill Lepore, a historian currently employed as Professor at Harvard University. She has had extensive experience with collecting and analyzing historical data on political processes. In a 2014 issue of *The New Yorker*, Lepore voiced many concerns regarding Christensen's theory of disruption under the header "The Disruption Machine". While not an academic contribution to the field, Lepore does point out some of the challenges of the theory.

One of Lepore's critiques of Christensen's work concerns his use of case studies for the reason that they are all examples of successful disruptive innovations. Other researchers, however, have pointed to examples of innovations that had the potential to disrupt but failed to do so. Danneels (2004) pointed to a study conducted by Sydney Finkelstein and Shade H. Sanford (2000) of the organization Iridium which, by the late 1990's, was set to be a first-mover in global telephony through low-Earth-orbiting satellites.

In response to Lepore's critique of his use of cases, Christensen has stated in a subsequent interview that he does not agree that he has only referred to successful cases. When reviewing the theory, this seems to be true. The paper by Christensen et al. from 2002 describes the results of gathering and analyzing data on a total number of 4334 disk drive models within a period from 1975 to 1998. Calculating the ratio between actual recording density of the drives and expected recording density as the architectural efficiency, Christensen et al. illustrate and support the statement that vertical integration strategies dominate the most demanding shares of the market. Similar but less extensive analyses were carried out for the computer industry, mortgage banking industry and microprocessor industry.

In the second edition of Interaction Design Foundation's textbook *The Encyclopedia of Human-Computer Interaction*, Donald Norman wrote a commentary to an adapted text on disruptive innovation originally from *The Innovator's Solution* (Norman, 2012). In this commentary, he states that while the theory is easy to understand, it is very challenging in practice. One of the reasons why is the point about the use of historical cases; although Norman frames it differently than Lepore.

Analyzing historical cases, certain reasons behind the success or failure of an organization can become very obvious. This was the case with Kodak, where framing of the challenge led them to react too quickly and without essential knowledge about the customer behavior. Norman argues that Kodak were simply developing digital cameras before customers were willing to accept a new standard in photography, but the review in this book showed other explanations. The reason aside, however, Norman's point is that the process seems cleaner in retrospect than it is in reality. Christensen, Verlinden and Westerman wrote on this matter that "Too often for decisions as important as these, their wisdom can only be judged with the benefit of history" (2002, p. 956), acknowledging that there is no empirical way to know if a decision is good before the consequences of that decision is known. This left a question of what an organization is then to do?

Christensen, Grossman, and Hwang suggested a disruptive innovation solution in 2009 to a specified context: the health care system in North America. Christensen had developed his theory from a management point of view so, for that book, he teamed up with Grossman and Hwang with experience in medicine. The reason for picking that particular angle is that, according to Christensen et al., the "Health care is a terminal illness for America's governments and businesses" (Christensen et al., 2009, p. xvi). In the book they develop a road map intended to accommodate the political conditions that require new solutions to be cheap while maintaining a certain standard of quality.

The basis for such a road map is an understanding of disruptive innovation that consists of three enablers — see Figure 7 for Christensen et al.'s visualization of this.

The three enablers that afford transformation in the form of disruptive innovation are technology, the business model, and the value network. In terms of the health care system, Christensen et al. identify the precision that technology offers in diagnosing patients as a technological enabler. While technology for precisely determining the causes behind specific symptoms might exist, a lack and confusion of business model innovation is argued to be the reason

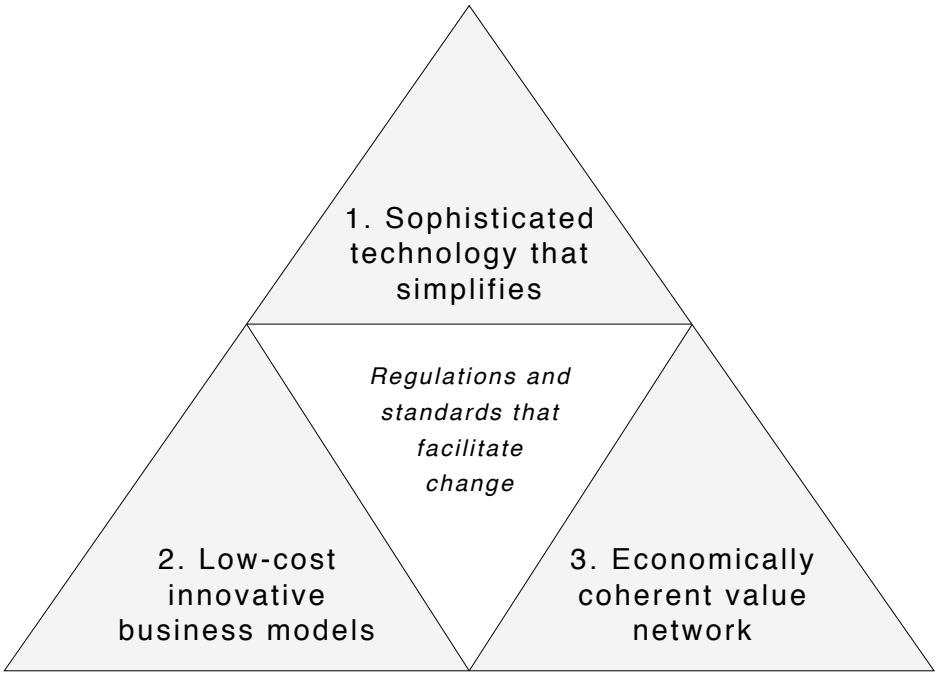

Figure 7: According to Christensen et al. (2009), disruptive innovation is enabled by three elements. Revisualized from (Christensen et al., 2009, p. xx).

why these solutions are still unaffordable to regular citizens. For example, no clear business model for hospitals has been developed, resulting in over-investments in activities that do not clearly contribute to a common goal: caring for patients. Lastly, they argue that previous attempts to disrupt the system had been unsuccessful due to not considering the value network currently established. This point is supported in Adner's analysis of the value network within the medical sector in his book *The Wide Lens* (Adner, 2012). In order for disruptive innovation to be successful, a new value network must be established around the disruptive solution. To this, Adner would add that a surplus for all stakeholders in the network should exist, because a value network is only as strong as its weakest link (Adner, 2012).

Referring back to the concepts of modularity and interdependence, Christensen et al. argue that since the system is currently modular, disruption will be significantly slower and less effective compared with what would be true of an interdependent system. Currently, practices operate independently from each other on improving their own service, which does not enable the transformation needed.

In this context, Christensen et al. reformulate the definition of disruption as well as the distinction between sustaining and disruptive innovations. They write that "The disruptive innovation theory ex-

plains the process by which complicated, expensive products and services are transformed into simple, affordable ones" (Christensen et al., 2009, p. 3). Similar to the original definition is the concept of simple and affordable products and services as a special enabler of disruption. However, the transformation from expensive to affordable seems, to the authors of this book, similar to the definition of developing sustaining innovations. This might be the source of some challenges in the theory.

On sustaining innovation, they write, "Innovations that drive companies up the trajectory of performance improvement, with success measured along dimensions historically valued by their customers, are said to be sustaining innovations" (Christensen et al., 2009, p. 4). Such a definition implies that the opposite, disruptive innovations, must then be defined by a trajectory of performance improvement not along dimensions valued by existing customers. An implication of this that has been underlined by Christensen previously is that disruptive innovation is a process with many factors of uncertainty.

An assumption throughout the literature reviewed in this book is that "In the end, it takes disruptive innovations to change the landscape of an industry dramatically" (Christensen et al., 2009, p. 8). This process is considered to have two points of departure. Usually, the process starts when organizations introduce products or services with lower cost. They argue that the business models of incumbents and entrants in this scenario are not different from each other. Both are interested in the value their product or service adds.

The second point of departure is a general shift in the business model from the focus on value additions to network facilitation. This happens, they argue, when developing the product becomes cheap and simple. YouTube is an example of the emergence of a facilitated network for easily exchanging content at a low cost.

The distinction between these disruption starting points is returned to in the following section as parallels to other distinctions in the same context might be drawn.

While the road map provided in *The Innovator's Solution* certainly affords transformation to a large system, it might be wondered if disruptive innovation is the only process through which an industry or a system can be transformed in terms of ruling business model paradigms. Whether or not that is the truth, Christensen et al. return to the concept of focusing on the job-to-be-done as the foundation for developing the new innovation.

O'Reilly and Tushman (2016) reformulate the first question posed by Christensen as follows: "Why do successful firms find it so difficult to adapt in the face of change – to innovate?" (O'Reilly & Tushman, 2016, p. ix). They concern themselves with leadership as a

factor of success. More specifically, they call for critically reconsidering separation as a strategy in developing disruptive innovations.

Ambidexterity is the term, O'Reilly and Tushman use to describe the capability of knowing when to separate, to what extent and how. Ambidexterity as a special capability for managing dual business models was also introduced by Markides and Charitou (2004) as part of an integration strategy. This was, as we might recall, only one of four strategies that an organization might choose to employ.

Within this direction, O'Reilly and Tushman reframe disruption from being a technology-based phenomenon to a matter of leadership. In some ways, their book shares characteristics with the book by McQuivey and Bernoff (2013) in that both focus on digitization as a new factor within the domain of disruptive innovation. By contrast, however, O'Reilly and Tushman distinguish between incremental, discontinuous and architectural innovations.

Incremental innovation means that products or services are improved so they become cheaper or more efficient. This innovation process is based on existing capabilities within the organization. By contrast, discontinuous innovations are capability-destroying. The technology is new to the organization and requires a transformation of its investment routines. Incremental and discontinuous innovations lie outside the disruptive innovation domain, O'Reilly and Tushman argue.

Inside the domain of disruptive innovation, they argue, is architectural innovation which initially only appeals to smaller segments of a market. Through continuous development, they improve the product or service until it appeals to the mainstream market and disrupts incumbents.

The concept of architectural innovation had been introduced several years prior to O'Reilly and Tushman's book, but with a different meaning than they present. A Professor at the University of Toronto, Joshua Gans, recapitulated this other meaning in relation to disruptive innovation in a book titled *The Disruption Dilemma* published the same year, 2016.

Supply and Demand

In 2016, Joshua Gans took a step back from disruptive innovation theory and looked at it in a broader, historical context. "…from Schumpeter to Foster to Christensen and Henderson, each gave support to the idea that those at the top are not as secure as many … believe" (Gans, 2016, p. 127). He argues that this particular focus has created a sort of paranoia where, as a Baader Meinhof phenomenon, organizations are now seeing disruption everywhere.

In the analysis by Kostoff et al., the discussion is broadened by reviewing differences between disruptive technologies, creating new competitive paradigms, and discontinuous technologies, bringing customers exponential improvements in value. As such, disruptive technologies are defined from an organizational perspective in contrast to the customer-oriented perspective on discontinuous technologies. The theories had widely differing definitions while also overlapping to a certain extent.

These differing definitions, however, resemble a categorization by Gans who distinguishes between demand-side and supply-side disruption. He writes that "…while demand-side disruption involves an established firm missing a certain kind of technological opportunity, supply-side disruption arises when an established firm becomes incapable of taking advantage of a technological opportunity" (Gans, 2016, p. 104). Where the view on disruptive technologies by Danneels (2004) and Adner and Zemsky (2005), among others, is based on competitive dynamics, Gans argues that this only represents one side of the discussion on disruption. The other side had previously been termed a supply-side perspective on the challenge of responding to discontinuous innovation (Henderson, 2006). Gans concurs with this division of perspectives and exemplifies why, through the development and release of the iPhone — a case we will return to.

In 2001, Christensen et al. had pointed out that a market consists of two performance trajectories. One is a measure of "…the ability of customers to utilize the product improvements introduced by manufacturers" and the other a measure of "…the actual pace of technological innovation" (Christensen et al., 2001, p. 81). In the attempt to keep profit margins high, managers aim to overshoot the trajectory of customer needs by making better products which can be sold to more demanding customers. This essentially creates the necessary conditions for demand-side disruption.

Gans describes a dilemma of the demand-side of disruptive innovation as coined by Christensen: It is not a challenge to identify potentially disruptive technologies or business models since they only have to satisfy the criterion of not performing well on standard features in a specific market. However, these are only potentially disruptive technologies or business models – if organizations could be sure that an entrant would be disruptive, they would know the next step to take. In fact, Gans argues that incumbents have a better chance in the existing market compared to the average entrant. We speculate if this advantage is diminished according to an increase in entrants. With such an increase, the capacity for innovation outside the incumbent organization would also rise.

An example is the education field where institutions such as Harvard and MIT have reacted promptly to online education offers such as Udemy without actually knowing whether or not this innovation will disrupt them in the future. While many arguments exist that online education is a growing market, investing out of fear is not a sustainable business model (Gans, 2016, p. 54).

Danneels stated that Christensen himself had looked at disruptive innovation from a marketing perspective. Slater & Narver (1998) also viewed disruption as a marketing driven challenge. However, Danneels also hypothesizes that Christensen's reading of marketing might have been "perfunctory" (Danneels, 2006, p. 3). This is based on an example that what Christensen and Raynor (2003) had contributed, among other points, about hiring "products to do jobs" (Danneels, 2006, p. 3) was not actually a contribution to the particular field of marketing since that notion had existed under the term benefits. Danneels' point is relevant when considering that Gans' categorization is based on the argument that Christensen deals with a market perspective on disruptive innovation.

Returning to the case of the iPhone, Gans asks whether this product was a disruptive innovation or not. In order for it to be termed disruptive, it must fulfill the criteria of the theory. This means that for the iPhone to be disruptive in terms of Christensen's theory, we would expect it to initially perform worse on attributes valued by the mainstream customer segment. This performance should then improve and begin to appeal to those mainstream customers. Finally, the iPhone would be the market leader. Gans argues that this way of assessing disruptive qualities is problematic. If the criterion for determining whether or not an innovation is disruptive is its initially worse performance on characteristics valued by customers, it is only possible to conduct the evaluation with hindsight. He hypothesizes that this is the reason why many, including Christensen, could not foresee the impact of the iPhone.

When reviewing the features that were implemented in the iPhone such as the music player and the Internet browser, the phone did indeed perform worse. Nokia and Research in Motion (RIM), the company behind the successful Blackberry phone, were not intimidated. From that perspective, it seems the iPhone had disruptive qualities.

However, Gans argues that the element of price, which is not explored by other researchers, meant that the iPhone was not disruptive. "Apple, in fact, asked customers to sacrifice features and pay more for privilege" (Gans, 2016, p. 37). Reflecting on Adner's article from 2002, Gans argues that the high price Apple was asking of their customers, while definitely creating competition, meant

that products such as RIM's Blackberry and Apple's iPhone could coexist in the market. So long as Apple continued to sell their phone at a high price, RIM could maintain its position by selling phones at a lower price. This concluded his analysis on the iPhone as an innovation that was not disruptive from a demand-side perspective.

Govindarajan and Kopalle (2006) had previously suggested a categorization of high-end disruptive innovations as innovations targeting customers who are willing to pay a significantly higher price than mainstream segments. From Gans' analysis, the element of price seems to have a different impact on the market than simply being a tool to establish new niche markets.

While Gans reaches the conclusion that the iPhone was probably not disruptive to incumbents in the mobile phone industry, he acknowledges that the smartphone as a general product concept certainly became the standard a few years later. On the quest to discover why, he visits the concept of dominant designs. Markides had also noted the potential importance of this concept when he wrote that "The shakeout is associated with the emergence of a dominant design in the market, which signals the beginning of growth in the industry" (2006, p. 23). He had defined a special category of potentially disruptive innovations, which he termed radical product innovations.

Gans writes that, with the introduction of the iPhone, a new phone design was beginning to develop that eventually became an industry standard. As data collected by Gans shows, the organizations that eventually failed to catch this wave were in fact aware of this new type of product. This might lead one to ask why they could not simply transform their product lines to accommodate the new standard.

Markides (2006) had described radical product innovations as the result of a supply-push from technology developers since they are rarely born out of explicit customer demands. Similarly, Gans terms this the supply-side of disruptive innovation. To support his analysis, he reviews theory on architectural innovation.

Architectural innovation was introduced in 1990 by Henderson and Clark who argued that the distinction between incremental and radical innovation was not adequately describing how seemingly minor technological improvements could have major impact on incumbents of an industry. Noting the differences between components and architecture, they show that architectural innovations require more resources compared with component innovation. Architectural innovation would require the organization to abandon embedded knowledge on their existing architecture and establish new procedures, both physically and mentally, in their development processes.

Returning yet again to the iPhone, the design was made up of components which were known to its competitors. Nokia and RIM pointed out that, for example, their hardware components performed significantly better in terms of network signal strength and battery time. However, when the product design became the standard, they could not adapt to the new architecture of which the components were part. When Google teamed up with HTC and Samsung, among others, and created Android smartphones, the price went down, effectively removing the foundation from which Nokia and RIM were able to compete with Apple. With that, Gans concludes that the iPhone was disruptive in terms of architectural innovation; or from a supply-side perspective.

Related to this, Christensen had explored the relationship between interdependent product architecture and modular, as part of the causal sequence of competitive advantage shifts in a market. Together with Verlinden and Westerman (2002), he argued that when the performance of a product intersects with the customer demand trajectory, organizations will benefit from a modular strategy that enables them to quickly cut away parts of the functionality of a product that exceeds customer demands and unnecessarily raises the price.

This seems similar to when Gans writes: "Supply-side disruption can arise when firms that have become intensely focused on improving components of an existing architecture are unable to respond when entrants are able to innovate on a new and ultimately more promising architecture" (2016, p. 47). As such, the two categories of disruption might not be mutually exclusive phenomena — a point that Gans also makes.

To accommodate this broader perspective on the drivers of disruption, Gans writes that "…the phenomenon of disruption occurs when successful firms fail because they continue to make the choices that drove their success" (2016, p. 9).

Kodak is an example of an incumbent that foresaw disruption; they were even among the first to hire Christensen after reading *The Innovator's Dilemma*. However, the organizations' attempts to enter the digital scene were highly affected by current products. The only option would have been to establish an entirely new line of products, creating an entirely new organization and making the existing ones obsolete. This route would have meant saying goodbye to the status as market leader and finding themselves among all other competitors in the digital photography industry. This makes Gans wonder if the ability to predict disruptive innovations is even of any value (Gans, 2016, p. 58). Similarly, with regard to architectural innovations, he speculates about the value of prediction if organizations are not able to act on the knowledge.

In 2014, Gans compared the dilemma of the theory to Heisenberg's Uncertainty principle. There is a limit to what can be known – and despite knowing the position of a certain entrant in the market, a prediction of characteristics such as momentum as well as any future positions cannot be made. He even writes that "…predicting disruptive events is very challenging, if not impossible" (Gans, 2016, p. 56). This still leaves the question of what to do.

Gans proposes that one of two decisions can be made when knowingly facing disruption; doubling-up or doubling-down. Doubling-down and focusing on the core products or services of the organization has, in many cases, shown itself ultimately to be an unsuccessful strategy. However, doubling-up requires an incentive within the organization: Is the investment in new areas worth it? Is the current threat large enough that the organization is willing to make the investment?

Doubling-up is about either matching the efforts of the competitor (or disrupter) or waiting to learn whether or not the competitor is actually disruptive or not and, in the case that they are, acquiring them if possible. The longer the established organization waits to acquire the entrant, the higher the cost and the lower the chance of the acquisition.

To nuance this, we might look back to 2006 when Christensen described disruption as a relative phenomenon that can only be determined in the relationship between two business models. When Markides (2006) concerned himself with the category of innovations that are new to the world, these are only new to a relative part of the world as pointed out by Christensen. With this knowledge, the complexity of the phenomenon is further increased.

Disruption, Destruction and Discontinuation

Self-contained, the phenomenon of disruptive innovation is complex. In addition to that, surrounding the theory of disruptive innovation is a vast field of research in innovation, management, market dynamics, and organizational transformation. Many of the concepts and theories appearing throughout this review have roots that go further back. For instance, Abernathy and Utterback laid the foundation for the concept of dominant designs in 1975 when they showed that certain patterns between innovation development processes and the competitive strategy of an organization exist.

However, it would not be feasible to cover all the directions in which these roots lead us. To conclude the review, we will look back to an article from 1984 by Abernathy and Clark: "Innovation: Mapping the Winds of Creative Destruction". The results presented in the article share similarities with Gans' conclusions and, for that

reason, provides a natural conclusion to this review. We take on a broader perspective with the concept of creative destruction and its relation to disruptive innovation in a subsequent chapter.

Disruption as a term for organizational failure was used before Bower and Christensen's article. Abernathy and Clark wrote that "… some innovations disrupt, destroy and make obsolete established competence; others refine and improve" (1984, p. 4). They state that innovative activity can exist in two domains: technology/production and market/customer. This distinction resembles the categorization made by Gans. They argue that a combination of activities in each domain creates a certain transilience to influence an established system. With influence, they do not necessarily refer to a destruction of organizations within that established system.

To describe this, Abernathy and Clark create a "transilience map" (1984, p. 7) representing four different categories of innovation: architectural, niche, regular, and revolutionary. See Figure 8 for a revisualized version of this. These categories are argued to be related to varying patterns of evolution as well as varying environments at

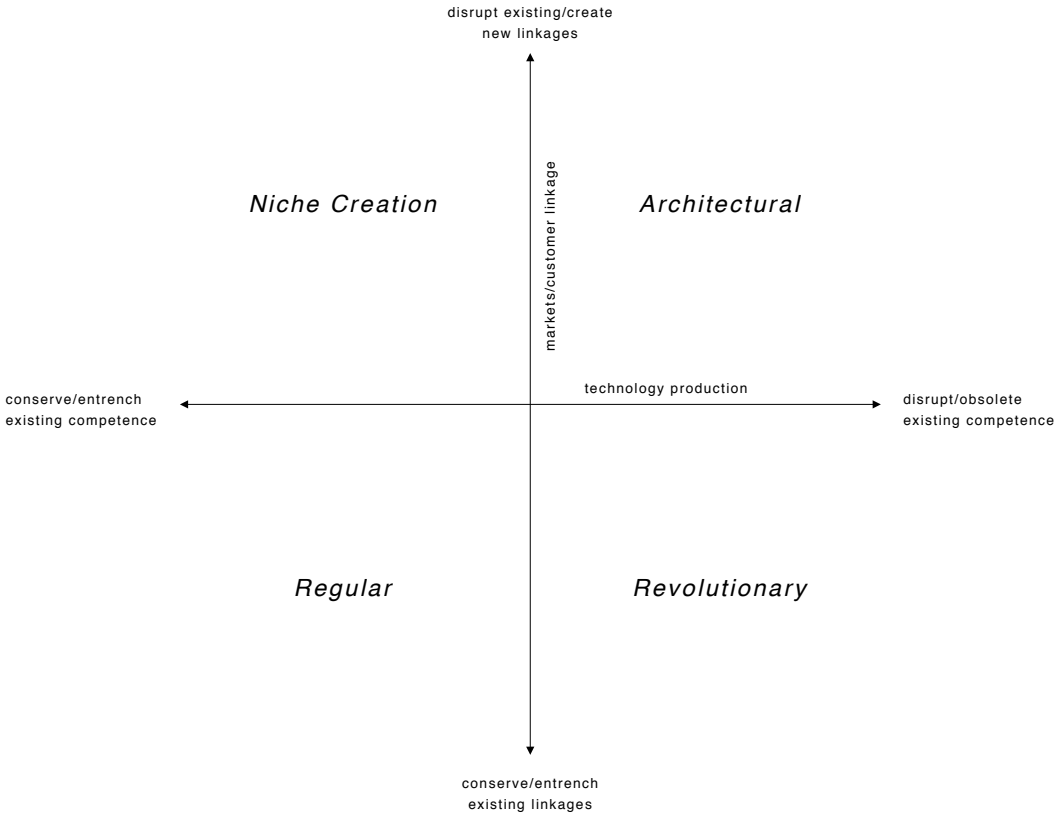

Figure 8: Four categories of innovation described by two dimensions of conserving or disrupting linkages or competencies. Revisualized from (Abernathy & Clark, 1984, p. 7).

a managerial level. Each category of innovation has different competitive significance depending on "…what it does to the value and applicability of established competence" (Abernathy & Clark, 1984, p. 7). As such, the transilience of an organization is determined by a combination of technological and market factors.

Architectural innovation is, similar to definitions already presented in this book, based on the configuration of a product, as well as the process of producing it. In terms of products, Abernathy and Clark separate characteristics that affect the knowledge relevant to the organization. These include performance, appearance, quality, and cost. However, how exactly to separate the performance of a product from its quality is not clear to the authors of this book. For architectural innovation, insights in relevant technology and user needs are essential in order to establish "…technical and marketing agendas that will guide subsequent development" (Abernathy & Clark, 1984, p. 7). This requires non-rigid structures to accommodate future changes.

Niche innovation, opposite architectural innovation, relies on established technology. Incumbents with certain technical competences can use this knowledge in targeting emerging markets. Abernathy and Clark exemplify the difference between these two types of innovation with Ford.

Introducing the Model T car in 1908, Ford took over a transportation market that had been dominated by bicycle and wagon manufacturers. Three themes are relevant to this, according to Abernathy and Clark. The new technological structure of the product clashed with prior structures, making it a challenge for incumbents to quickly respond with similar products. Another theme seems similar to the concept of dominant designs when Abernathy and Clark emphasize the durability of the new concept. A creative synthesis between established technologies, such as electronic controls and thermodynamic engine designs greatly advanced the field of transportation. Finally, this innovation process was supported by other innovations in the manufacturing process, such as new methods of assembling components.

20 years later, several competitors had appeared, and the Model T was performing much worse compared with newer models. Having limited time to develop a product, Ford had to rely on established competences. They built the Model A which was faster and had a lighter but more powerful engine. With this, they transitioned from developing architectural innovation to niche innovations. The Model A targeted an emerging market of "moderately priced family car[s]" (Abernathy & Clark, 1984, p. 11) but was sold through existing distribution channels.

The idea that incumbents can employ a niche market strategy on the basis of their existing competencies seems far from the theory reviewed in this book. While Ford did not manage to secure their leading position for long with the Model A, the case shows that such a strategy might be viable in certain situations. Since the new design was not based on a new architecture, it was easy for competitors to copy the design — but they still had to invest the time to copy and improve the design before introducing competing products. This emphasizes the importance of timing.

Where niche innovations were defined by incumbents targeting emerging markets, regular innovation "…involves change that builds on established technical and production competence and that is applied to existing markets and customers" (Abernathy & Clark, 1984, p. 12). The effect of this type of innovation is typically cumulative; an organization continuously improves the cost and performance of a product. Ford's Model T was initially priced at $1200 — a price that fell to $290 through 18 years. In the context of disruptive innovation, this would be considered sustaining innovation.

Coupling those definitions makes additional sense when considering Abernathy and Clark's definition of revolutionary innovation next. They write that this type of innovation "…disrupts and renders established technical and production competence obsolete, yet is applied to existing markets and customers…" (Abernathy & Clark, 1984, p. 12). Another formulation to take note of is: "It thus seems clear that the power of an innovation to unleash Schumpeter's "creative destruction" must be gauged by the extent to which it alters the parameters of competition, as well as by the shifts it causes in required technical competence" (Abernathy & Clark, 1984, p. 13). It might be argued that Christensen's theory explains how this is possible.

Abernathy and Clark had, like Christensen, looked at historical data to find patterns that could explain this. They compared their findings to the concept of scientific paradigms by Kuhn, which could provide an explanation for choosing the dimension of regular versus revolutionary innovation. Long periods of regular innovation would take place before a revolution would occur and initiate a new period of regular innovation. This resemble Buxton's model of "The Long Nose of Innovation".

Viewing the transilience map with this knowledge, Abernathy and Clark notice that all four types of innovation had shaped the car industry both in terms of the market and in terms of technological development. As an example, the transition from architectural to regular innovation would typically be characterized by the establishment of a dominant design. "With this the focus of innovation

shifts from meeting emerging needs with new concepts, to refining, improving and strengthening the dominant design and its appeal in the market" (Abernathy & Clark, 1984, p. 14).

Similarities in the categorization by Gans of supply-side and demand-side disruption can be found here. Both in terms of regular and revolutionary innovation, organizations can become victims of demand-driven and supply-driven disruption. Abernathy and Clark argue that architectural and niche innovations require insights in user needs as opposed to regular and revolutionary innovation based on technology push.

During periods of regular innovation, managers seek consistency and stability for the purpose of creating a kind of robustness against what Abernathy and Clark term "supply disruptions" (1984, p. 20). In the light of Christensen's theory, this assessment of the decision-making process seems correct. In addition, Christensen adds that such a strategy would seem rational but ultimately be unsuccessful. However, since regular innovation is driven by the introduction of improved technological components, we might look back to Henderson's point that the challenge of disruption is a challenge to organizational competence (Henderson, 2006). As a side note, we recall Henderson's work in the early 1990s on defining architectural innovation in the light of which this point of view was created. Organizational competencies in the face of new waves of innovation seemingly lie at the heart of this dilemma. To explore this, we make a final journey back in time.

A Broader Perspective

In this chapter, we will take a look at a concept that many have speculated to be the origin of disruptive innovation theory: creative destruction. We put forward and support a hypothesis that *The Innovator's Dilemma* describes a specific cause behind creative destruction.

The following departs in the detailed, but perhaps not exhaustive, historical review by Gans (2016).

Describing him as the "mentor" playing a crucial role in the original story of disruption theory, Gans (2016, p. 15-17) begins his review of this story with Joseph Alois Schumpeter. Schumpeter introduced the concept of creative destruction in 1942 as a description of the evolution of capitalism: when new, radical innovations are introduced to a market, they make obsolete existing products or services. Gans writes that "…Schumpeter found evolution rather than equilibrium to be the appropriate narrative for what was occurring in the economy" (Gans, 2016, p. 16).

In the preface of the 2016 edition of *The Innovator's Dilemma*, Christensen writes that "…Michael Raynor … has noted that disruptive technology is probably the cause behind the "creative destruction" that economist Joseph Schumpeter observed to be the primary engine of economic progress more than half a century ago. I think Michael is right" (Christensen, 2016, p. x). He had discussed this previously in an interview conducted in 2001 where he calls disruptive technology "…a great case study of Joseph Schumpeter's creative destruction theory" (Christensen, 2001, p. 10). What might seem ironic to readers here, is Christensen's note that the concept of creative destruction was framed by S-curve evolutions of technological innovation, the very concept that lead to Christensen's discovery, but that disruptive innovation is another type of creative destruction related to business models.

From the above, it seems that Christensen did not intentionally anchor his theory in the concept of creative destruction.

Neither Gans nor Raynor were first in considering the relationship between the theory of disruptive innovation and Schumpeter's concept. Kostoff et al. also noted the overlap with creative destruction, citing Kondratief and Schumpeter for describing how "waves of technological change" (Kostoff et al., 2004, p. 142) redefine organizational structures and existing markets. Erber (2004) framed his study of the broadband communication industry with Schumpeter's concept in relation to the theory of disruptive innovation.

Interestingly, even though it seems from Christensen's statements that he had not considered the relationship, the first article on disruptive technologies by Christensen and Bower (1995) had the

subheading, “Catching the Wave”. Additionally, the paper by Christensen, Craig, and Hart (2001) leaves a mention of the concept in an argument that, if creative destruction is fostered, the process of disruptive innovation will entail the replacement of incumbents by disruptive entrants. This is followed by a section titled “Creative Disruption”, arguing that “…economic growth is tied to the infrastructure that supports disruptive technologies” (Christensen et al., 2001, p. 91).

Through their analysis of the economic growth in Japan from the 1960’s until the 1980’s, Christensen et al. hypothesize that supporting disruptive innovation processes could be a key to such growth in poor countries because fewer competitors exist in the market for rural poor in developing countries. From the organizations’ point of view, Prahalad (2004) later made the point that a great market potential exists for selling to poor people. Inclusive capitalism is the term he uses to describe that specific process of creating value for the organization and the people, respectively.

The reason behind Christensen et al. (2001) conducting this particular analysis might stem from work that Christensen did with a former student named Schumpeter Tamada, a Japanese man whose father had been an admirer of Joseph Schumpeter (Christensen, 2001).

Tamada had worked within the Japanese Ministry of International Trade and Industry where he had realized that he could not come to a conclusion on how to turn the Japanese economy around. Together with Christensen and other researchers, he found that the challenge Japan was facing had to do with the fact that their infrastructure did not support creative destruction of business models.

King and Tucci nuanced the view that “…the era of incumbent firms is over” (2002, p. 184). Even though technological development is the root of an increasingly higher rate of market change, their study showed that experience is not necessarily the root of failure to transform with that change. It can be the root to success in making niche market transitions.

Previously described by Christensen among others, the word disruption comes with a number of associations in the English language. A similar point could be made on the word destruction. Where disruption is a process in which established organizations lose significant market shares to a niche product or service moving into the mainstream market, the word destruction insinuates a process through which something seizes to exist.

It might be speculated that Schumpeter’s concept describes an effect that, among other theories, could be caused by the innovator’s dilemma as described by Christensen. In that way, creative

destruction also becomes a measure with which to disrupt. In an interview, Christensen indicated such a way of distinguishing the concepts (ELIACE, 2011). He stated that, knowing the theory of disruptive innovation, organizations "…can be creative without being destroyed" (ELIACE, 2011).

Predicting the Unpredictable

"Modern management is an illusion" — a translation of the header of a Danish article from 2015, where Stacey comments on the idea that a manager should know the unknowable. In the early 1990's, Stacey had put forward a theory that rather than considering management as a system with fixed components, it would benefit managers to be aware of the human relations that affect their organization.

We have conducted a review of literature concerning disruptive innovation theory that shows a number of attempts to describe a phenomenon that is highly driven by uncertain factors. This is possibly he reason why the predictability of Christensen's theory has been so widely discussed. Managers are handed method after method meant to provide them with a sense of security that, at the core of the phenomenon, cannot be provided. Gans wrote that "The key to dealing with disruption is to understand that it emerges surrounded by uncertainty" (2016, p. 10). While Christensen has made a similar statement (Christensen, 2006), he remains positive that parameters for success can be uncovered.

In an interview conducted by Susan Adams for *Forbes Magazine*, Christensen argues that the focus on customer analyses in business schools has clouded theory on innovation to such a degree that success might seem completely unpredictable. Professor Roberto Verganti, who has advocated for at least a decade against user-driven design approaches, recently published the book *Overcrowded* (2017) where he argues that capturing new business opportunities requires innovators to ask why we need a certain product, rather than how it works — the keyword here being meaningfulness. Similarly, Christensen states that organizations should focus on the context in which the customers find themselves. This context creates certain jobs-to-be-done (Adams, 2016). This notion had been introduced in *The Innovator's Solution* (2003) as part of a disruptive positioning strategy, and further elaborated throughout the literature by Christensen.

Christensen, Hall, Dillon and Duncan wrote an article on the subject in 2016. With an increase in digital products, data has never been more abundant or accessible to organizations than now. The use of big data is discussed both in academic and industrial contexts. Still, organizations are not more successful with their innovations. Christensen et al. speculate that the amounts of data mislead managers into thinking that certain patterns in their datasets can be interpreted as mechanisms of causality. However, from such datasets, it can be impossible to know the reasons behind a particular person's actions. For that reason, Christensen et al. argue that

the context, or circumstances, surrounding the said person is more important to understand than specific characteristics such as age, height, or other variables typically used as parameters. Using data-rich models, managers become "masters of description but failures at prediction" (Christensen et al., 2016, p. 62), they write.

As early as 1950, Armen Alchian, Professor of economics at the University of California, wrote on economic analyses that "…where foresight is uncertain, "profit maximization" is *meaningless* as a guide to specifiable action" (Alchian, 1950, p. 211). He suggests a model to create positive profits rather than maximized profits through imitative and trial-and-error behavior. Such a method is argued to be useful in situations where certain elements of making a foresight render it imperfect, or where managers face a challenge that is too complex to solve — one example of this might be wicked problems, as defined and described by Rittel and Webber (1973) where a problem and a definitive set of solutions cannot be conclusively defined. Gans wrote in short terms: "Uncertainty is Endemic" (2016, p. 62).

A main point from Alchian is the fact that, besides being lucky, an organization can try to adapt to various situations. Luck mainly revolves around the environment adopting organizations — regardless of whether or not they are trying to be adopted. He exemplifies this with plants growing on the sunny side of a roof; not because they consciously choose the side, which provides them with the most optimal conditions, but simply because they grow faster when exposed to more sunlight. The behavior most appropriate for certain conditions will be the most likely to secure survival.

"The approach suggested here … does not regard uncertainty as an aberrational exogenous disturbance" (Alchian, 1950, p. 221). Alchian proposes that complete uncertainty should be the starting point rather than starting with a specific motivation — an approach that must be abandoned whenever uncertainty arises.

The initial conclusions in Stacey's work were similar to this in that he considered the chaotic patterns of nature also to be present in organizations.

As we leave the review at this point, we are left with some questions. Is *The Innovator's Dilemma* about organizations focusing on improving their current product to the extent that they over-serve a low-demanding segment of their customers allowing for other organizations to steal that segment? Or is it about organizations focusing on their current customers' wants and needs to an extent that they neglect to explore a broader territory of surrounding their current market? Perhaps it is both?

If disruptive innovations follow trajectories from performance dimensions different from the core products or services of an organi-

zation, how does that characterize the process of self-cannibalization? A general question that might be considered in all of this is: Can organizations become more capable in identifying points of orientation for future innovations?

While Christensen has stated that the dichotomy of radical and incremental innovation cannot be directly compared to disruptive and sustaining innovation, it seems there are still links between these typologies. For that reason combined with the above results, we suggest that a piece in the puzzle of developing strategic methods in this specific context is further research into the change these types of innovation brings. Such research would also benefit from a look into the concept of innovation itself.

Tellis had conducted a Google search in 2006 for disruptive innovation which, at the time, gave approximately 150.000 hits. Compared with other related innovation types, disruptive innovation showed significantly higher levels of interest. Radical innovation gave only 58.000 hits, and competence-destroying innovation gave 55. Even though hardly significantly indicative of the scattering of research interests, we thought it interesting to conduct a similar search now that 10 years have passed and wondered if a similar pattern would appear. The result is indeed interesting. As expected, all innovation types yield more hits than before, and radical innovation tops disruptive innovation with 434.000 to 426.000 hits. What this suggests is of course only speculative, but the search shows that the interest in innovations that bring with them a drastic change, be it organizational or in terms of the meaning our products afford, is increasing.

In 2006, Christensen wrote that he might have been better off following Grove's suggestion of naming the theory "the Christensen effect" in order to stay clear of the many associations with the word disruption (Christensen, 2006, p. 42). However, while disruption might be an effect, the theory departs in a cause; the innovator's dilemma. Strictly in terms of the dictionary reading of the word, organizations can be disrupted in many ways — not just from organizations taking advantage of niche markets created by a performance surplus. As such, disruption is not a strategy. It is not a method that organizations can use to be successful. We propose that a more detailed investigation into what the causes and effects in this context are, would be valuable. Directly translating the cause of an effect, in this case the innovator's dilemma, to a method has not been possible so far.

Christensen stated in an interview with *Forbes* that "The theory of disruption is a theory of competitive response. But alone, it doesn't help you predict the success of a new product" (Adams,

2016). His suggestion of focusing on the jobs-to-be-done as a way of overcoming the dilemma might be a step in a fruitful direction, but it could also be speculated that such a strategy serves as a more general purpose than disruptive innovations.

At the beginning of this book, we set out to answer the following question: Has the core of disruptive innovation theory changed since its first inception? We have found that a number of related concepts are shaping the theoretical discussion. Together, these core concepts of disruption both help and confuse the development of the theory.

Not written in an organizational or economic context, this quotation on war still seems fitting to describe the state of mind of many being swept up in this new trend:

> "A few uncomplicated thoughts seem to account for their decisions — either that, or the explanation lies in various emotional states; and one is left with the impression that great commanders manage matters in an easy, confident and, one would almost think, off-hand sort of way. At the same time we can see how many factors are involved and have to be weighed against each other …. The function of theory is to put all this in systematic order, clearly and comprehensively, and to trace each action to an adequate, compelling cause."
>
> (Clausewitz, 1989, pp. 577-578)

The military generals mentioned in our quotation of Clausewitz are examples of leaders being aware of the uncertainty of the outcome of a process but at the same time understanding the potential impact of changing the initial parameters of that process. For future work in disruptive innovation theory and practice, we have provided this systematic overview as a point of departure. We suggest that any researcher or practitioner within this field also consider related theory in organizational design, culture and management to gain a full and nuanced understanding.

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When companies fail, several reasons (some more likely than others) can be turned to in order to explain why. Managers look for these typically interrelated networks of reasons in attempts to secure themselves and future companies from the same failure happening again. This necessitates knowledge, which, based on past experience, provides forecasts and is operational at an early stage.

One reason behind company failures has been termed *The Innovator's Dilemma* by Clayton M. Christensen. Christensen's influential book of the same title and subject has founded a direction within innovation management that, through recent years, is gaining increasing amounts of attention.

Lundgaard and Rosenstand advocate that in operationalising theory of disruptive innovation, a common understanding of its most obvious limits and potentials must be achieved. This entails a review and reflections on what the theory initially was, how it has developed, and what is has become. Furthermore, this stance entails a look into the broader context of the theory so as to not diminish its value through simplification. These two aspects are the core of the book.

The authors' literature investigation draws upon a deep selection of literature specifically concerning disruptive innovation so as to provide researchers, students, and managers with an overview of the specific area. Further reading into organizational design, culture, and management is encouraged in order to fully understand the complex reality of disruptive innovation for organizations.

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