

PDF hosted at the Radboud Repository of the Radboud University Nijmegen

The following full text is a publisher's version.

For additional information about this publication click this link.

<http://hdl.handle.net/2066/160151>

Please be advised that this information was generated on 2019-01-20 and may be subject to change.



Available for free online at <https://ojs.hh.se/>

Journal of Intelligence Studies in Business Vol 4, No 3 (2014) 63-78

Disruptive Intelligence - How to gather Information to deal with disruptive innovations

Dirk Vriens¹, Klaus Solberg Sølilen²

¹ Radboud University, Netherlands

Email: d.vriens@fm.ru.nl

² Halmstad University, Sweden

Email: klasol@hh.se

Received November 15, accepted December 5 2014

ABSTRACT: Disruptive innovations are innovations that have the capacity to transform a whole business into one with products that are more accessible and affordable (cf. Christensen et al. 2009). As Christensen et al. argue no business is immune to such disruptive innovations. If these authors are right, it might be relevant to be able to recognize these innovations before they disrupt a business. Incumbents may use this information to protect their business and others may use it to participate in the disruption. Either way, gathering information about potential disruptive innovations is a relevant activity. The production of this information (we call this information “disruptive Intelligence”) is the topic of this paper. In particular, we analyze disruptive innovation theory and formulate several intelligence topics which may help in predicting disruptive innovations. In addition, we formulate several ‘biases’ which may impair the production of ‘disruptive intelligence’.

KEYWORDS: Disruptive intelligence, disruptive innovation, business models, disruptive blindness

1. Introduction

Disruptive innovations are innovations that have the capacity to transform a whole business into one with products that are more affordable, convenient and accessible (cf. Christensen et al. 2009). The idea of “disruptive innovation” (and its related theory) was developed by Christensen and colleagues (e.g. Christensen, 1997, Christensen and Raynor (2003), Christensen (2006), Christensen, Grossman and Hwang (2009) Christensen and Eyring, (2011)) and has attracted attention by scholars and practitioners alike. A disruptive innovation, as Christensen defines it, is initially a new product or service with inferior performance on the attributes most appreciated by mainstream customers of the old product or service and, hence, it doesn't appeal to these customers. It does, however, attract the less demanding, more price sensitive customers of the old product and/or customers who value the innovation's other performance attributes. In time, the innovation improves in such a way that it also appeals to mainstream customers of the old product (cf. Christensen and Raynor, 2003; Christensen et al., 2009, Govindarajan and Koppalle, 2006b or Schmidt and Druehl, 2008 for a similar description of disruptive innovations).

As pointed out by Christensen (Christensen 1997; Christensen and Raynor, 2003 or Christensen et al., 2009) “[...]incumbent firms often fail to recognize the threat posed by a disruptive innovation.” (Schmidt and Druehl, 2008). As disruptive innovations target “less profitable customers in less attractive tiers of the markets” (Christensen et al. 2002, p. 23) or even non-consumers of the old product, incumbents lack the motivation to compete. The effect is often that incumbents, when the disruptive innovation has evolved into a product that appeals to their mainstream customers, are too late to react and may even lose the competitive struggle. In such a case a disruption of the business has occurred.

Christensen and his colleagues give many examples of disruptive innovations that had a dramatic impact on incumbents. For instance, in the 1950s Sony's portable transistor radio disrupted the then existing radio-business; in the 1970s the mainframe business was disrupted by the invention of the micro-processor enabling the production of PC's; Amazon.com has (to some degree) disrupted the traditional bookstores and eBay disrupted (to

some extent) the traditional auction-business (examples taken from Christensen et al. 2003, who provide an extensive list of disruptive companies – e.g. pp. 56-65). As Christensen et al. (2009) argue, no business is immune to disruptive innovations. If this is true, then, of course, it is of utmost relevance to be able to recognize these innovations before they start to disrupt a business. This is true for incumbents who may want to prevent their demise and for those who want to launch or participate in disruptive innovations. Either way, gathering information about actual or potential disruptive innovations is a highly relevant activity – a notion that has been put forward by other authors as well (e.g. Christensen et al., 2002; Adner, 2002; Paap and Katz, 2004, Danneels, 2006; Schmidt and Druehl, 2008). We call this information “disruptive Intelligence” and the main question for this paper is how to produce such intelligence.

To understand the production of disruptive intelligence, it is necessary to understand the nature of disruptive innovations. That is, we need to understand what a disruptive innovation is (which is a difficult task in itself, as Danneels (2006) points out) and, as Adner, 2002, noted, we need “... an understanding of the conditions that give rise to disruptive technologies [...]” (p. 667). Based on “disruptive innovation theory” as developed over the past decades we can gain such understanding and use it to guide the production of disruptive intelligence.

It should be noted that gaining insight into information needed to deal with disruptive innovations is a topic that has already been addressed by several authors (e.g., Paap and Katz, 2004; Christensen et al., 2002, Christensen et al., 2003). However, since these attempts, disruptive innovation theory has matured (cf. Christensen 2006 about the development of the theory, and Christensen et al., 2009 for an updated version). In newer versions the understanding of the relevant characteristics of disruptive innovations and their drivers has evolved. Based on this improved understanding we are able to give an updated version of the required “disruptive intelligence”.

The main question of our paper is important, not only because of its relevance for strategy formulation (fighting or engaging in disruption), but also because a systematic, up-to-date attempt at answering it seems to be lacking in the existing literature.

To deal with the question of producing disruptive intelligence, this paper is organized as follows. First, we summarize disruptive innovation theory (section 2). This will present us with a description of disruptive innovations and with an overview of their drivers. In section 3, we use relevant aspects from disruptive intelligence theory to discuss three important topics related to the production of disruptive intelligence: (1) how do we know whether a market is prone for disruption? (2) how do we know whether disruption is going on?, and (3) how can we prevent blind spots in gathering disruptive intelligence?

2. Disruptive innovation theory

To understand how intelligence needed to deal with disruptive innovations can be produced, we first need to describe disruptive innovations in some more detail. In particular, based on an understanding of (1) the concept of disruptive innovations and (2) their drivers we will be in a position to direct intelligence efforts. This section discusses disruptive innovations and their drivers based on disruptive innovation theory as it has been developed over the last twenty years. Section 3 will go into disruptive intelligence.

2.1 Disruptive innovations

To explain what disruptive innovations are, Christensen often starts with explaining so-called sustaining innovations (e.g. Christensen et al., 2003; Christensen et al., 2009). A sustaining innovation is an innovation that improves the performance of an existing product or service “[...] with success measured along dimensions historically valued by their customers” (Christensen et al., 2009, p. 4). These innovations set out to improve the performance on the attributes valued by mainstream customers (cf. Govindarajan and Kopalle, 2006b, p. 27). Typical examples are innovations leading to faster cars, disk drives with better storage capacity, or radio’s and TV’s of better quality (cf. Ch 2003; 2009)

As Christensen explains, a series of sustaining innovations typically results in products and services that “over-serve” costumers - they lead to a performance that most customers can no longer utilize (Christensen et al., 2009, p 5). At some point, for instance, faster cars don’t really make sense given the constraining circumstances for using this speed (Christensen et al., 2003, p. 32-33;

Christensen et al., 2009, p. 4). As the market for particular customers can be divided into different tiers, Christensen et al., (2003, p. 33) explains that the degree of over-serving is different for each tier. Typically, the low-end, less demanding and/or price sensitive part of the market may be “over-served” sooner than the high-end part of the market. The reason for the focus on sustaining innovations is that incumbents “[...] are striving for better products that they can sell for higher profit margins to not-yet-satisfied customers in more demanding tiers of the market” (Christensen et al., 2003, p. 34). In all, “[...] a sustaining innovation targets demanding, high-end customers with better performance than what was previously available”. (p. 34).

Given this explanation, disruptive innovations are contrasted to sustaining innovations. Disruptive innovations do not aim to make existing products better, rather, they introduce products that actually underperform compared to existing products (cf. Christensen et al., 2003, p. 34). Yet, “[...] they offer other benefits – typically they are simpler, more convenient, and less expensive products that appeal to new or less-demanding customers” (Christensen et al., 2003, p. 34) and not to mainstream customers. Some of the examples Christensen and his colleagues provide us with are: disk drives with less storage capacity but increased portability; cheap, portable computing devices with less computing power (early “pc’s”), and cheaper cars with less functionalities. As Christensen et al., 2009 argue, these disruptive innovations offer “affordability, accessibility and convenience” over the performance attributes that are valued by the mainstream customers.

Now, as disruptive products gradually improve – due to their own sustaining innovations, they eventually appeal to the mainstream customers of the old product. (Christensen et al., 2003; Christensen et al., 2009). In terms of the examples Christensen provides: personal computers improved up to the point that they appealed to the users of mainframes; transistor radios improved to match the quality of the large vacuum tube radios, the storage capacity of portable disk drives increased to match the performance of their less portable predecessors. The improvement of a disruptive product may eventually lead to a disruption of the business: which starts to occur when mainstream customers prefer the new product.

In his earlier work, Christensen et al. made a distinction between “new market disruptions” and

“low-end disruptions” (Christensen et al., 2003). A low end disruption targets at the low end tiers of the market – costumers who are less demanding and more price sensitive. These are the customers with a high degree of “over-serving” who are quite willing to buy a product with less functionalities – they would buy less powerful cars; disk drives with less storage capacity, PC’s with less processing speed, etc. Gradually, the product improves “from the low-end up” and starts appealing to more demanding tiers of the market. A typical feature of low-end disruptions is that they “grow by picking off the least attractive of the established firms’ customers”. (Christensen et al., 2003, p. 46). Christensen discusses the example of “so-called steel mini-mills”, mills that were able to produce steel far more efficiently in far smaller settings than the established steel mills. At the outset, the new technology enabled these mini-mills to produce steel of a quality that only appealed to the least demanding tier of the market. However, as technology improved, mini-mills were able to produce steel of a quality that also appealed to the more demanding tiers (Christensen et al., 2003 pp. 35-39).

A new market disruption introduces products that “compete against non-consumption” (Christensen et al., 2003, p. 45). That is, they open up for a new market of customers who couldn’t afford the old product and/or who are attracted by the new product’s additional performance attributes. The first portable Sony transistor radios were of less quality than the existing “table top” radios. However, their low cost and portability appealed to a new type of customer: teenagers who could now listen to music whenever and wherever they pleased (cf. Christensen, et al. 2003, p. 104/5). In general, Christensen argues, new customers are attracted by affordability and or additional attributes like accessibility and convenience. In his language: the products enabled new customers to realize a job they wanted to have done, something the old product couldn’t. After a series of sustaining innovations, these products improve and start to appeal to customers of the old product.

It should be noted that disruptions can also be “hybrids” (Christensen et al., 2003, p. 47). For instance, the introduction of the cheap Toyota Corolla (made possible because of Toyota’s efficient production-system) is an example of a hybrid as it appealed to low-end “over-served” price-sensitive customers, while it also attracted

new customers who previously couldn’t afford a car (Christensen et al., 2003, p. 64).

An important aspect of Christensen’s work is that incumbents fail to react adequately to disruptive innovations. When a low-end disruption occurs, stealing away their less profitable customers, incumbents are often not willing to compete. In such a case, they will be motivated to focus on the more profitable tiers of the market (cf. Christensen et al., 2002, p.23) – a reaction they may later regret. When a new-market disruption occurs they may have even more trouble to react, as the product doesn’t even target their existing customers. Govindarajan and Kopalle (2006b) list several reasons why incumbents have a hard time reacting to disruptive innovations. For instance, the new product does not appeal to mainstream customers because it has a different “package of performance attributes at the time of introduction” (p. 191), and because it performs less on the attributes valued by them; Moreover, the new product may be “[...] introduced in an emerging or insignificant niche market” and “[...it...] offers a lower margin” (p. 191). As a result, a recurrent theme in the history of disruptive innovations is that incumbents often realize too late that their business is being disrupted.

2.2 Drivers of disruptive innovations

After having discussed the idea of disruptive innovation, a next question is how these innovations are brought about. To answer this question Christensen et al. (2009) identify three drivers or enablers: a “technological enabler”, a suitable “business model” and an adequate “value network” (2009, p. xx ff).

2.2.1 Technological enablers

A technological enabler of a disruptive innovation refers to “sophisticated technology whose purpose it is to simplify, it routinizes the solution to problems [...] (Christensen et al., 2009, p. xx). Technology is taken to be a broad concept, as it refers to any “[...] way of combining inputs [...] into outputs of greater value” (Christensen et al., 2009, p. 1). And if such a “way of combining inputs” is simpler and/or more affordable than the existing technology, then it is a potential enabler for a disruptive innovation. Defined this way, a technological can refer to a technical innovation (e.g. the micro-processor – making the task of

“computing” simpler and more affordable) or to a specific organizational structure and way of performing tasks (e.g. the Toyota production system – making the production of cars more efficient and hence the cars themselves more affordable). A technological enabler can be used to make *products* simpler, more convenient or more affordable (e.g. the micro-processor enabling the production of personal computers which were much simpler devices than mainframes) and/or it can make the *process of production* simpler and more cost-efficient - and hence, its resulting products more affordable (e.g. the Toyota-production system made production more cost-efficient, and as it happened, the micro-processor also simplified the process of design and assembly – Christensen et al., 2009). As a final remark, it should be noted that disruptive technology doesn’t always need to be a new technical invention – it can also refer to a new use of existing technology (e.g. using the Internet in a way that may disrupt a business, like eBay did according to Christensen et al., 2009, p. 31).

2.2.2 Business models as enablers of disruptive innovations.

In the course of developing disruptive innovation theory, business models became more central (Christensen, 2006). In later versions of the theory, it is argued that disruptive innovations can only come about if there is a “supportive” business model. A relevant question then becomes: what is a business model and how does it enable disruption?

Business models

Christensen identifies a business model as a particular arrangement of four components: a value proposition, processes, a profit formula and the organization’s resources (cf. Stabell & Fjeldstad, 1998; Christensen et al., 2009, p. 9).

A value proposition, in essence, refers to the value offered to customers. It indicates how a product or service may help “[...] customers do more effectively, conveniently, and affordably a job they have been trying to do” (p. 9). Although each firm has its own specific value proposition, Christensen discusses three types of value propositions (following Thompson (1967) and Stabell and Fjeldstad (1998)). He identifies a “value adding process” (with its basic value proposition to transform inputs into outputs – e.g. retailing, restaurants, or car-manufacturers) a “solution shop”

(with its basic value proposition to solve clients’ unstructured problems – e.g. a professional service firm) and a “facilitated network” (with its basic value proposition to link clients / supply and demand – e.g. a bank)¹.

The processes-part of a business model refers to the primary process activities and how they are related (Stabell and Fjeldstad; 1998) – although Christensen et al. define it broader (including the primary and secondary “way[s] of working together to address recurrent tasks in a consistent way” (2009; p. 9, 10). As Stabell and Fjeldstad (1998) argue, three different types of process-activities and relations can be identified (related to the three types of value propositions discussed above). If a value proposition falls in the class of “value adding process”, its primary process activities are typically those of Porter’s value chain: inbound logistics, operations, outbound logistics, marketing and service (Porter, 1985, 39-40). These activities are mainly related sequentially and contribute – in sequence – to the final product or service. As Thompson (1967) explains, these activities and their sequential ordering make sense if the process is structured; well understood, predictable and/or routine to a considerable degree. If a value proposition aims at dealing with unstructured problems (a solution shop), then the main process activities are diagnosis (problem finding), design (propose a solution to the problem), implementation (of the proposed solution), and evaluation (of the implemented solution) (cf. Stabell and Fjeldstad, 1998, p. 415). Moreover, as these problems are unstructured, the activities are mostly carried out in a “cyclical or spiraling” way (cf. Stabell and Fjeldstad, 1998, p. 415). That is, carrying out activities is based on the feedback received during or after the execution of activities, and based on that feedback it may be necessary to redo those activities (cf. Thompson’s (1967) description of intensive technology). If the value proposition is to link clients (facilitated network), the main primary activities are network promotion, service provisioning and infrastructure operation (Stabell and Fjeldstad, 1998, p. 415). Moreover, as the authors point out, these activities can be carried out in parallel. So, each of the three types of value

¹ Even though the basic distinctions derive from Thompson’s technology typology identifying long linked, intensive and mediating technology, we will refer to the three labels used by Christensen et al. (2009, p. 20 ff).

proposition is related to its own set of process-activities.

A profit formula refers (1) to the profit and cost drivers, and (2) to the way customers pay for products and services. With respect to the first aspect of the profit formula, Christensen et al. write: that it “[...] defines the required price, markups, gross and net profit margins, asset turn, and volumes necessary to cover profitably the costs [...]” (2009, p. 9). It refers, for instance, to the choice to make products in large volumes with low margins or in small volumes with a high margin. Christensen further specifies the way customers pay for products and services into three classes: fixed price, fee-for-service and membership fee. Again, dependent on the type of value proposition, a particular profit formula is more or less suitable. As a value adding process relates to predictable routine processes, its key profit drivers are (economies of) scale and a fixed price can be charged. Similarly, as a solution shop deals with unstructured, hence unpredictable problems, charging a fee-for service is more appropriate. Moreover, given their unstructured nature, processes cannot profit from capacity utilization made possible by routinization. Instead, they depend on the (expensive) human expertise with carrying out unstructured processes. Therefore, a key profit driver is the reputation of those involved in the process while a cost driver is their expense (cf. Stabell and Fjeldstad, 1998). The mediating value proposition may also profit from scale and capacity utilization (as it can, for instance, use the same technical network to connect many clients) and it can and often does supply its services for a membership fee (see Christensen et al. 2009, p. 20 ff.).

The last element of a business model, as described by Christensen et al. 2009, refers to the resources that are employed to carry out the processes and deliver the value proposition – including both human and other resources (tools, ICT, machinery, etc.). Again, a difference can be made according to the type of value proposition. In a value-adding process the focus is on technology enabling the swift sequential operation of activities (e.g. conveyer-belt technology, or systems optimizing the work-flow) and on low cost human resources. In a solution shop, human expertise is the most valuable asset (although tools and equipment are not unimportant either). In a mediating value proposition the focus is on the infrastructure enabling the network (e.g. ICT/internet and those facilitating the network).

In all, as Stabell and Fjeldstad (1998) describe, three basic business models can be identified, each having their own characteristic business model components:

- (1) A value adding process business model (with as its value proposition: transforming inputs into outputs; with Porter’s value chain process-activities, with standardization and economies of scale of profit drivers, charging on a fixed price basis and with the focus on resources enabling standardization and low cost).
- (2) A solution shop business model (value proposition: solving unstructured problems; process activities related to iteratively dealing with unstructured problems (diagnosing them, designing and implementing solutions and evaluation); relying on expensive experts of good reputation and charging on a fee-for-service basis).
- (3) A mediating business model (with its value proposition to link clients; process activities related to promote, operate and facilitate the network linking clients; with capacity-utilization of the network as its profit-driver and charging a membership fee).

Business models as enablers of disruptive innovations

After describing business models, it is relevant to discuss how they enable disruption. As Christensen argues, disruptive innovations always entail a change in a business model (i.e. a change of one or more of their constituent components). They always entail the change of the value proposition. That is, based on some disruptive technology, a new value proposition is to bring to the market a product or service that can help customers to do more effectively, affordably, conveniently a job they have been trying to do than the products or services that are currently available. This is the case in low-end disruptions, in which the new value proposition is to sell more affordable products with less functionalities to “over-served” customers. It is also the case in new-market disruptions, in which the new value proposition is to target new customers with a product that helps them to do a job that the old product wasn’t able to do.

Following a change in value proposition, processes and resources should be formulated and aligned to fit the new value proposition. If the new value proposition is to serve the low-end, price sensitive part of the market, the business model typically needs to allow a firm to “compete profitably while pricing at deep discounts” (Christensen et al., 2002, p. 26). This, in turn, requires a different profit formula, more efficient processes and/or resources than what incumbents have. A different alignment of business model components is also required if a value proposition targets at new customers with a product having other performance characteristics.

In fact, one of the important “lessons” from disruptive innovation theory is that disruption always needs a change in business model. According to Christensen, a common theme concerning disruptive innovations is that incumbents are often aware of the disruptive technology but refuse to change their business model, because it is – to them - a sound way of making money. The new technology doesn’t serve their mainstream customers as good and profitably as the products they currently produce. So, why change their value proposition, processes and resources? Even if the new technology starts to lead to better products taking away customers at the low end of the market – incumbents tend to stick to their business model in the hope to make money by serving the more demanding customers (with sustaining innovations). As Christensen (2006) summarizes: “[...] a disruptive innovation is financially unattractive for the leading incumbent to pursue, relative to its profit model and relative to other investments that are competing for the organization’s resources” (p. 49). In other words, a business model may present a form of “disruptive blindness” on the part of incumbents. In fact, Christensen’s advice to incumbents, who want to react properly to a disruptive threat, is to start a new business unit with a different business model tied to products with the new disruptive technology.

So, disruptive innovations require a change in business model. In this way, they enable disruption. Christensen et al. (2009) go on to discuss two different *types* of disruptive business model change: one in which the type of value propositions stays the same, and one in which the type of value proposition changes.

A disruptive business model change that doesn’t lead to a new type of value proposition is one in which a firm either attracts the low end of the

existing market or targets at non consumers with a similar type of value proposition but with a different profit formula, different resources or more efficient processes. Examples of such a business model change regarding low end disruptions include the steel mini-mills or Toyota (see earlier examples). Their basic value proposition remained the same (value adding process), but a new process-technology (efficient mills) or a more efficient way of relating process activities (Toyota) made (low end) disruption possible. An example of a change in business model within the same type of value proposition attracting non-consumers might be Sony’s transistor radios appealing to a new type of customers: a new market disruption in a business with a “value adding process” value proposition.

A business model change can also result in a new business model with a value proposition of a different type – for instance HBO and Netflix are currently disrupting the home-video market. Until recently, this market was dominated by DVD-producers (with sustaining innovations like blue-ray DVD). HBO and Netflix offer customers to watch movies and series whenever they want by offering them access to their network containing movies and series. In essence, their value proposition belongs to the facilitated network type while the DVD-producers had a value-adding process business model. Amazon did something similar for the business of selling books, taking it from a value adding process to a facilitated network business, serving the low end of the market according to Christensen et al. (2009).

Christensen et al., 2009, argue that a business model change which succeeds in moving from a solution shop business to a value adding process or a facilitated network business are especially powerful. Solution shop value propositions are – given their nature – business models leading to expensive products that can only be made by experts. If a technology becomes available which enables doing solution shop activities in a predictable, routine way, a business may be disrupted. This is so because making these products no longer relies on complex esoteric knowledge and experience of expensive experts, but based on the new technology, it becomes possible to standardize and routinize production, requiring less expertise. An example may be the diagnosis of infections (example adapted from Christensen et al., 2009). Once, this was the exclusive realm of medical specialists who might determine the type of infection based on trial and error and their vast

body of experience. As such it was a solution shop activity. Once diagnostic tests became available based on which a range of infections could be determined with certainty – the process of determining infections became much more affordable and accessible. Most of these tests can now be administered routinely by less expensive medical staff, taking less time to determine the result (although of course, specialists are still needed if standard tests yield no results). Christensen argues that Ford did something similar for the automobile industry: by standardizing the process of assembling cars he changed from a solution shop activity to a value adding process (resulting in much cheaper cars).

Something similar holds for changing from a value adding process business to a facilitated network – which often allows for delivering services at lower production and overhead cost.

So, disruptive innovations always need a change in business model, so as to support the potential of the disruptive technology. In the first place, a disruptive innovation always entails a change in value proposition (as simpler, more convenient and/or more affordable products are offered). This change can result in a different type of value proposition. Next, a disruptive innovation requires a reformulation and realignment of business model components (relative to the business model of incumbents) - so as to make sure that the disruptive product can be brought to the market as a low-end or new-market innovation. In fact, as Christensen et al., 2009 argue: to make disruptive innovations succeed, they require their own proper business model (which should be different from the business model of incumbents).

In Christensen, Grossman and Hwang, 2009, the above logic of business models as enablers of disruption is further extended. The authors argue that organizations trying to mix different types of business models are at a disadvantage. In such a case, an organization may produce a product requiring solution shop activities and one which can be produced with value adding process activities. If they use the same resources and the same profit formula with respect to both types of products, then the value adding process product may become too expensive. In general, Christensen et al. (2009) argue that mixing types of business models in this way often leads to less affordable and accessible products. As a simple example, consider a group of psychologists offering two types of services: tailor-made psychological counseling to deal with

difficult psychological disorders and more routine services like administering IQ-tests. The first type of activity is a solution shop activity requiring expertise and iterative problem solving, while the latter is a routine value adding process activity requiring far less expertise. Now, if both types of activities are carried out by the same set of specialists charging a fee for service, the routine activity ends up being relatively expensive. A better idea is to make sure that the two types of activities have their own “business model” – e.g. their own set of resources, activities and profit formula. One line of business would be tied to routine activities (like IQ tests). The associated business model has a value adding process proposition, routine and standardized activities, relatively inexpensive personnel and it could charge a fixed price. The other line of business would house the solution shop activities carried out by the more expensive experts. IQ tests can become cheaper and experts can focus on delivering complex counseling. Both lines of business may improve. Although this is a simple example, Christensen et al. (2009) explains that “disentangling” business models, as he calls it, and making sure that value propositions of a different type are served by different business models is a powerful way of improving business models (one he uses to “disrupt healthcare institutions”, Christensen et al., 2009). By discussing disentangling business models, Christensen argues that if you mix business models, you may not reap the benefits of a potentially disruptive innovation. This is a specific reformulation of the adage that “disruptive innovations need their own proper business model” – as discussed above. However, given existing technology, disentangling business models may sometimes itself be a way to make products more affordable and accessible (as the example above shows – and Christensen et al., 2009 provide many more in the context of health care disruptions).

2.2.3 A value network as enabler of disruptive innovations

A disruptive innovation does not only require disruptive technology and a supportive business model – it also needs a “value network”. A value network is a “commercial infrastructure” [...] through which [...] the disruptive product or service... is delivered. (Christensen et al., 2009, p. xx and p. xxviii). It consists for instance of companies that help to market, produce, sell and

provide services for the new product; a network of e.g. producers, suppliers, service-companies, and vendors. Selling mainframes, for instance, relied on a different value network than selling PCs (which could, for instance, be sold by retailers). As Christensen et al. argue disruption innovations need a fitting (and often different) value network. Producing and selling in high volume and low margin (low end disruption) requires a value network aimed at low cost. Similarly, attracting new customers (new market disruption) requires at least a value network with access to these new customers. A change in value proposition type (e.g.

moving from a value adding process to a facilitated network business) also means a different value network (e.g. one helping to build and maintain the facilitated network instead of one sustaining production processes).

To summarize, this section discussed both a description of disruptive innovations (as an innovation leading to more affordable, accessible and convenient products) and their three drivers (technological, business model and value network) – see table 1. In section 3, we use these ideas to discuss disruptive intelligence.

Disruptive innovation		Drivers of disruptive innovations	
Description: An innovation eventually leading to more affordable, accessible and convenient products	types: low-end (starting at low end of existing market); new market (attracting non-consumers of old product)	1. Technological innovation (making products or processes simpler)	
		2. Business model change	
		Components - value proposition - processes -resources -profit formula	Type of Business model -solution shop -value adding process - facilitated network
		3. Value network (for making and selling the new products)	

Table 1: description and drivers of disruptive innovations.

3. Disruptive intelligence

The goal of this paper is to understand the production of “disruptive intelligence” that is, information that may help to see whether a disruption is possible or whether a business is being disrupted. To structure the discussion of disruptive intelligence, it is helpful to see that the main question concerning disruptive innovations is:

Is (will) a technological innovation (be) available that can be used, along with an appropriate business model and value network, to bring a product or service to the market that may eventually grow into a product that is more affordable, accessible and/or convenient than the products that are currently available?

We will call all information that may help to answer this question (before a business is actually disrupted) “disruptive intelligence”. This

intelligence is relevant for incumbents as they may want to protect themselves against and make sure they react adequately to disruptions. It is also relevant for those considering participating in disrupting a business as they may want to know whether a potential disruptive innovation may stand a chance.

Regarding the production of disruptive intelligence, three related questions are relevant. The first is: Are disruptions possible in this business? This question relates to whether a particular business is susceptible to disruption. Based on this information it becomes possible to anticipate a possible disruption and pro-actively deal with it. This information is also relevant for those planning a disruptive attack; the prospects of such an attack are of course better in a disruption-prone business. The second question revolves around finding out whether a disruption may currently be happening. Have new entrants (or

incumbents) introduced a disruptive innovation? Obviously, the sooner incumbents have this information, the sooner they can react. Moreover, for those who are engaged in a disruptive attack, it is relevant to have an idea of the potential competition and whether their innovation is indeed a disruptive innovation. A last question relates to “disruptive myopia” – a bias in the capacity to produce disruptive intelligence. It seeks to make clear whether incumbents (and even the disruptive aggressor) may have (developed) systematic barriers preventing them from seriously answering the two above questions (and hence from discovering disruptive intelligence). Below, we will deal with each of these questions and in doing so we will present some intelligence-topics that could be pursued to answer the question. We want to note, however, that we don’t claim that these intelligence topics form a complete list – but we do argue that these topics will help to increase the possibility to deal with disruptions.

3.1 Are disruptions possible in this business?

Finding out whether a business is “disruption-prone” it is relevant for two (related) reasons. The first is that you may want to know whether a business is susceptible to a disruption at all (this knowledge can raise ‘the level of disruption awareness’ – which may help incumbents to be alert and would-be entrants to discover opportunities). The second is that you may want to find out whether a particular innovative idea has a disruptive potential.

3.1.1 Is any disruption possible in this business?

Following Christensen and his colleagues, a business may be disrupted if its existing products or services are expensive, difficult to access and/or may not be convenient. Christensen et al. hold that “nearly every industry, at their outset [...offered products and services...] that only people with a lot of money can afford them, and only people with a lot of expertise can provide or use them.” (2009, p xix). So, nearly every industry was or is disruption-prone. Moreover, after a disruption occurs, a business may be disrupted even further... leading to more affordable, and accessible products. So, a first – very crude – indicator of “being disruptive-prone” is the degree to which a business has products or services that are not affordable and inaccessible. With respect to the degree of unaffordability we

need to identify whether the products “can only be bought by people with a lot of money.” Here, we need to be careful though, because (as a disrupted business may be disrupted again) “a lot of money” seems to be a relative measure. In disruptive innovation theory, the degree of accessibility relates to several ideas. It sometimes refers to the degree to which a product can be provided by people with a lot of expertise (like eye-surgery once was), sometimes to the degree to which a product can be used by people with a lot of expertise (like mainframe computers), and sometimes to the degree to which customers can get access to a product or service (e.g. if one has to buy it at some central location, or if acquiring it means waiting – like many healthcare services). Often, difficult-to-provide and difficult-to-use products have these characteristics because they rely on ‘solution shop’ activities. An innovation transforming these activities into a value-adding process or facilitated network business may be disruptive (e.g. innovations have made certain eye-operations routine-activities decreasing their cost dramatically - cf. Christensen, 2009). A facilitated network may help to solve problems with acquiring products (e.g. access to films and series via HBO solves going to a retailer). So – a first indicator is the degree to which a business provides expensive and inaccessible products / service.

A second indicator refers to the degree to which current products and services help clients to “do a job they have been trying to do” (cf. Christensen et al. 2003, Christensen et al. 2009). This is an extremely relevant point but also difficult to examine. If an existing product doesn’t help clients to do their job properly – the introduction of a product that does, may disrupt the business. This is, of course, a truism, but as it turns out many companies have a hard time pinning down the job of customers as they often frame their markets in terms of product- or client-characteristics (which are categories used by those selling the products), while the “job” “should be the fundamental unit of marketing analysis” (Christensen, et al. 2009, p. 11) as it represents that for which “customers hire a product or service”. So, markets shouldn’t (only) be analyzed using lists of product- and customer categories as they may miss the job customers hire a product for (this was already pointed out by early intelligence authors, like Geroski, 1988). Discovering the true “job” requires a different approach than existing marketing techniques. It requires a deep understanding of the life of

customers and the role existing products have therein, which calls for a more ethnographic approach in which customers' socially embedded desires and actions are related to the use of products.

A further indicator of a disruption-prone business is the degree to which customers are 'over-served' as Christensen et al. 2009 call it. As discussed, this refers to the difference between the functionalities offered by a particular product or service and the functionalities that customers are able to utilize. The higher this 'value', the more susceptible the business is for a low-end disruption. This indicator may even be determined for different tiers of the market; and especially relevant information would be how many of the current customers would be willing to buy a product with less functionalities. Another related idea is to determine how many customers would still be interested in buying the product if it was stripped of its non-essential, excess functionalities (some research shows how markets can be approached in this way – e.g. Adner, 2002)

Establishing whether a new market disruption might be possible is difficult as it needs to research the demands and behavior of non-consumers. For a part this overlaps with the indicators stated above for low-end disruptions (as current non-consumers may be non-consumers because they don't have enough money to buy the product). However, if a product is to appeal to non-consumers for other product characteristics – one needs to find them. This, in turn, means gaining an understanding of the 'job' of (non) customers in order to identify possible other contexts of use or competing products. An idea might be to identify groups of non-consumers and ask under which conditions they would use a similar product (again, other authors have put forward "methods" that can be used to identify relevant non-consumers – e.g. Geroski, 1988). If such products can be identified (and if these conditions include the use of products with less functionalities than the current ones) it may indicate that a business is disruption-prone. An example in this case would be the discovery that portable radios could be used by teenagers who were happy with them because it meant that they could listen to music whenever and wherever they wanted – which they valued more than quality of the transmission.

A related indicator relating to a low-end and new-market disruption may be the degree of saturation of the "dominant product characteristic"

– the characteristic most valued by mainstream customers (cf. Paap and Katz, 2004). The saturation-value is the value above which "more of the characteristic" doesn't present extra value to a customer (in fact, this value may be one way of operationalizing the degree of "over-serving"). Paap and Katz (2004) give the example of storage-capacity of disk-drives. At some point it exceeded the capacity that customers could use and valued. Hence, they argued, other characteristics may be introduced that can be of value (in the example: the portability of disk-drives). So, the moment saturation is reached, a business may become vulnerable to disruption.

In all – to determine whether a business is "ready to be disrupted" one might consider the following indicators:

1. The degree to which a business revolves around expensive products;
2. The degree to which a business revolves around inaccessible products;
3. The degree to which a business delivers products that do not completely fit the "job" customers are trying to do;
4. The degree of "over-serving" of products in a business;
5. The degree to which consumers would be willing to buy the product if it were stripped of its non-essential functionalities;
6. The degree to which other contexts of use can be identified for simpler versions of the product;
7. The degree of saturation of the dominant product-characteristic (relates to 4).

3.1.2 *Is this innovation potentially disruptive?*

The above indicators give a general impression of the possibility that a business can be disrupted, creating a certain "disruption-awareness". The question we now turn to starts off with an idea for an innovation and aims at finding out whether this particular innovation might be a disruptive innovation.

In part, this question has already been addressed by Christensen et al. (2002, 2003). In these texts, he gives so-called 'litmus-tests' for determining whether an innovation is potentially a low end disruption or a new market disruption. Here, we briefly summarize these tests, as they may be guiding the production of disruptive intelligence.

In a new market situation, Christensen et al. (2002) give three tests (1) the innovation must be a simple product appealing to non-consumers (p. 24-25) (as the authors write, the Apple II was introduced as a toy for children; *ibid* p. 25); (2) the innovation should help customers to do a job they have been trying to do “more easily and conveniently” (p. 25). For instance, people have for a long time been trying to get rid of goods they no longer needed (e.g. through garage sales or occasional flea-markets), and applications offering online auctions (e.g. eBay) were a way of helping people to do get rid of their stuff more conveniently, reaching a far larger audience (cf. Christensen et al., 2009, p. 31). (3) the innovation should target customers who were unable to do a particular job because of “lack of money or expertise”. (c 2004, p. 24). The online auction-sites offered mentioned above offered the majority of people who could not afford the services of a real auction-company to participate in an auction. (cf. Christensen et al., 2003 and Christensen et al., 2002, p. 24-25. for the three tests).

According to Christensen et al. 2002, if an innovation is to bring about a low-end disruption it should pass the following two tests: (1) the degree of “over-serving” should be high enough and (2) it should be possible to make a low-cost business model (“[...] one that enables entrants to compete profitably while pricing at deep discounts” (Christensen et al. 2002, p. 26).

So – given an innovative product of service (based on some technical driver) the above tests can direct intelligence efforts. But besides these tests, disruptive innovation theory presents more clues to determine whether some innovation may disrupt a business. These clues relate to the possible changes in the business model an innovation may bring about (Christensen et al. 2009). For instance, if a particular innovation enables the routinization or standardization of solution shop activities, then a business will most probably be disrupted. Something similar holds for an innovation that enables a change to a facilitated network business. A helpful question here is whether an innovation may help customers to help themselves (e.g. by some online or network service).

Yet another clue relating to business model change is whether a disentanglement of a particular business model (of form of business model innovation, as Christensen et al. 2009 call it) may help to offer products or services more affordably. As we discussed earlier, making sure that different

types of value propositions are served by different business models can often make products more affordable and accessible. So, disruptive intelligence can entail a form of “business model introspection” with the aim of trying to find out whether disentanglement is possible in your company.

So, topics for disruptive intelligence regarding the question whether a particular innovation (either a new product or service or a business model innovation) is potentially disruptive are:

1. “Is the innovation a simple product appealing to non-consumers?”
2. “Does the innovation allow customers to do a job more easily and conveniently?”
3. “Does the innovation target at customers who haven’t been able to do a job themselves because of lack of money or expertise?”

These 3 topics are Christensen’s (Christensen et al., 2002, p. 24-25) “litmus tests” for new market disruptions.

4. Does the innovation target at a market in which the current products have a high degree of ‘over-serving’?
5. Can the supportive business model be changed in one that produces at low prices?

These 2 topics are Christensen’s (Christensen et al., 2002, p. 26) “litmus tests” for low-end disruptions.

6. Does the innovation make a change in business model type possible (e.g. by routinization or by offering a mediating network)?
7. Is it possible to disentangle the current business model?

3.2 *Is disruption going on?*

In this section we deal with information that may help to establish whether a business is currently being disrupted; i.e. whether some disruptive innovation has been launched. This is a difficult question: others may introduce some innovation sharing the characteristics of a disruptive innovation (e.g. it may underperform and only appeal to some of your customers) but it may well be that this product just doesn’t turn into a disruptive product. That disruptive innovations

have certain characteristics on the outset, doesn't mean of course, that all innovations sharing these characteristics will be disruptive. The problem of predicting whether an innovation which is launched is potentially disruptive has been noticed by several authors (e.g. Christensen et al., 2003; Danneels, 2006; Govindarajan and Kopalle, 2006a, b). Yet, based on disruptive innovation theory we feel that some clues may help to increase the possibility of establishing an answer to the question whether a business is being disrupted.

First of all, it should be noted that all information gathered to answer the question from the previous section (is our business a disruptive-prone business?) is helpful to answer the question in this section. If we know that we operate in a disruptive-prone business then we need to be extra alert and take threats of disruptive candidates seriously. Moreover, if we notice that an innovation has been launched sharing some of the characteristics of a disruptive innovation, we may want to acknowledge whether it passes Christensen's "litmus tests". If so (combined with knowing that the business is a disruptive-prone market) we should be very alert.

On top of this information some other clues may be helpful. For instance, if an innovation seems promising one may expect a certain number of start-up firms (Christensen, et al. 2011). What may even be more telling is when an incumbent starts a different business model tailored to this innovation. As Christensen et al. argue an incumbent cannot incorporate a disruptive innovation in its current business model; it needs to launch it from a different business model (like IBM who started a separate business unit to produce PCs – cf. Christensen et al. 2009). So, information on incumbents starting up a new business unit with a new business model is relevant disruptive intelligence'.

An interesting technique for predicting the disruptiveness of an innovation that has been introduced is using s-curves which describe the sales-pattern of most disruptive innovations (e.g. Paap and Katz, 2004; Christensen and Eyring, 2011). Sales of disruptive innovations usually follow an s-curve pattern, with few, but steadily growing number of sales at the beginning, followed by a abrupt growth in sales, again stabilizing eventually. If sales of a new product have reached the steep part of the s-curve, it may be too late. So, the trick is to predict whether some sales-growth (at the start of the s-curve) will turn into a sudden

growth in sales (in the middle of the s-curve). One method that may shed light on this issue is to rescale sales on a logarithmic scale. As Christensen (2011, 96) shows, the s-curve then turns into a line-graph based on which it may be easier to see whether the initial sales fit in an s-curve, and hence are predictive of a sudden growth.

Another relevant indicator has to do with losing tiers in a market. Finding out that incumbents have lost the least-demanding low-end tiers of the market and concentrate on the more profitable tiers is a relevant indicator of a disruption. In fact, the more tiers that are lost, the more one can be sure that the innovation is disrupting a business. Unfortunately, this information may be a very late warning signal.

Yet another indicator has to do with a change in value-network. As the disruptive innovation targets at different customers or may entail a change in business model, one may expect a change in firms that are part of the value network. Once, for instance, retailers are willing to give the new product a chance, this may signal such a change. One may also expect a growth of start-up firms in the value network.

A last indicator we want to mention here is a change in business model of (new) competitors. It may be a sign of disruption if new entrants have a different type of business model, or if competitors disentangle their business model.

So, in order to determine whether a business is being disrupted, the following indicators (besides the ones mentioned in the previous section) may be relevant:

- (1) The number of start-up firms
- (2) Are incumbents starting up a new business unit with respect to the new innovation?
- (3) Are sales of the innovation following the usual pattern of disruptive innovations?
- (4) Are incumbents losing (low-end) tiers of the market?
- (5) Is the value network changing?
- (6) Do new entrants have different (types of) business models?
- (7) Are competitors disentangling their business models?

3.3 *Do we suffer from disruptive blindness?*

The last intelligence related topic we want to discuss in this paper is whether a company may have developed systemic biases preventing it to produce disruptive intelligence and act on it. Following disruptive intelligence theory,

incumbents are often not motivated to react to disruptive attacks as they aim for the least attractive tiers of the market. In the face of such attacks, incumbents are motivated to focus on the more attractive, profitable tiers of the market. Moreover, as Christensen and Raynor, 2003, argue, incumbents favor sustaining innovations as they target at the profitable tiers of the market, and hence, increase (short-term) share-holder appreciation. Investments in (uncertain) innovations that target at less profitable tiers simply do not appeal to shareholders. So, the current way of doing business may prevent incumbents to engage in disruptive innovations and often realize that they should have reacted when it's too late. Phrased differently, because their way of doing business is deeply rooted in one particular business model, they fail to see the threat of disruption. This is a common theme in disruptive innovation theory and if incumbents want to protect themselves against disruption, it is relevant to investigate to what extent they suffer from such 'disruptive blindness'. In this section, we suggest some indicators of this blindness, which can be used to create a certain awareness of existing biases.

Before we discuss some indicators of "disruptive blindness" we would like to point out that some of the "business blind spots" that were put forward by Gilad (1996) in the context of competitive intelligence, can be reframed in terms of the reaction-pattern of incumbents to disruptive innovations. Gilad (1996) discusses, for instance, "false or biased assumptions" as a blind spot which may impair strategic decision making. An example he gives is the biased assumption of many large firms that they do not have to pay attention to smaller players on the market. But often, as he describes, large players pay dearly for this blind spot when a small player launches a successful product. Based on disruptive innovation theory, it becomes possible to better understand this blind spot. In fact, disruptive innovation theory shows that this assumption may in fact be a valid assumption with respect to sustaining innovations. It also shows that new entrants (often small players) most of the time win the battle for disruptive innovations, because incumbents are stuck to their business model (in which the newly introduced, inferior product, not appealing to their mainstream customers doesn't make much sense). So, based on disruptive innovation theory it can be understood that "not paying attention to small players" may not

be a bias per se, but that it fits a response pattern of incumbents to disruptive innovations.

A first indicator of "disruptive myopia" might be the answer to the following question: "Do we actively try to answer the above two questions (3.1 and 3.2) related to disruptive intelligence?" Obviously, if no effort is put in answering these questions, one probably has no clue about whether one operates in a disruptive-prone market, whether particular innovations have a disruptive potential, or whether a disruption may be going on. In fact, in order to produce disruptive intelligence, one needs to make an effort, which should translate itself in an infrastructure related to producing intelligence. It should, for instance, be someone's responsibility; and time and resources should be made available. Not having an infrastructure tailored to producing disruptive intelligence is an indicator of disruptive blindness.

Another indicator of disruptive blindness relates to the "forces that shape the process of innovation" as Christensen and Raynor 2003 (p. 9 ff.) describe. As these authors argue, innovative ideas are "sifted and shaped" by middle managers in many organizations, who "typically hesitate to throw their weight behind new product concepts whose market is not assured" (Christensen and Raynor, 2003, p. 11). They need to be as sure as possible about a product's potential (as both budget decisions and their career depend on it) and often rely on the feedback of "significant customers". But as a disruptive innovation often does not appeal to these customers, disruptive ideas tend to be deselected. Sustaining innovations, however, do appeal to this set of customers, thus having a tendency of being preferred. So – the process of innovation of incumbents has a bias towards sustaining innovations (and against disruptive ones). To deal with this blindness (i.e. to at least become aware of it) it may be an idea to keep track of the innovative proposals and the reasons for their selection or rejection. This list may indicate the degree to which sustaining innovations are preferred over potentially disruptive ones. And, against the background of knowledge about the degree of disruptive-proneness of a business (e.g. operationalized by the degree of over-serving customers) one may decide whether the actual proportion of sustaining/potentially disruptive ideas is dangerous or not. Another idea might be to make sure that reasons for selection/rejection do not only refer to the feedback of significant customers, but also to a kind of 'disruptive reasoning'. Ideally such

reasoning includes an (“job-to-be-done”-related) analysis of the appeal of the idea to the low-end of the market or to non-consumers and an analysis of the potential of the product in appealing to mainstream customers.

A third indicator relates to the reaction if one is confronted with losing a part of the (low end of) the market. Often, as Christensen and Raynor, 2003, describe, incumbents are quite happy to focus on the more profitable tiers of the market. However, precisely this attitude is an important indicator of disruptive blindness.

A fourth bias that incumbents often display may be called the “business cycle fallacy” which roughly goes like this: If business is booming, we don’t need to invest in innovations whose prospect is unclear and if business is in a slump we can’t afford to invest in innovations whose prospect is unclear”. This, again, is a “disruptive innovation de-selection”-mechanism. As Christensen et al. 2002 argue it should be the other way around: if things are looking good – see if a separate business unit around a potential disruptive innovation can be set up; if things look bleak, you may well be too late.

A last indicator, related to disruptive blindness we want to mention in this section has to do with knowledge about disruptive innovations. The degree to which all involved in the process of innovation has knowledge about disruptive innovations and their drivers is an important indicator of blindness. Without such knowledge, one cannot help to fall into the traps of biases deselecting disruptive innovations (cf. Christensen et al., 2002, p. 30).

4. Conclusion

In this paper, the idea of ‘disruptive intelligence’ is presented. Based on disruptive innovation theory, we discussed the nature of disruptive innovations and their drivers. It is apparent that if one wants to deal with the threat (or opportunity) of a business disruption one needs to produce “disruptive intelligence”. That is, one needs to produce information about (1) whether a particular business is “disruptive-prone” and (2) whether a disruption may be happening. In this paper, which is purely analytical and descriptive, we have provided several indicators that can be helpful in answering these two questions. In fact – these indicators can be taken to be helpful indicators in producing disruptive intelligence. Moreover, we discussed

some indicators that may reveal if companies are suffering from “disruptive blindness” – i.e. indicators showing that companies may have difficulties producing disruptive intelligence.

Even though we think that our paper contributes to a more systematic description of the information needed to deal with disruptive innovations, we are not there yet. In particular, the list of indicators can be extended – based on further conceptual and practical explorations. Empirical studies should also follow.

5. Literature

- Adner, R., 2002, When are technologies disruptive? *Strategic Management Journal* 23(8): 667-688.
- Christensen, C.M., 1997. *The Innovator’s Dilemma*. Boston MA: Harvard Business School Press.
- Christensen, C.M., 2006. The ongoing process of Building a Theory of Disruption. *Journal of Product Innovation Management* 23: 39-55.
- Christensen, C.M., and Eyring, H.J., 2011, *The Innovative University*. San Francisco (CA): Jossey-Bass.
- Christensen, C.M., Grossman, J.H., and Hwang, M.D., 2009, *The Innovator’s Prescription*. New York: McGrawHill.
- Christensen, C.M., Johnson, M.W., and Rigby, D.K., 2002.. Foundations for Growth: How to identify and Build Disruptive New Business. *MIT Sloan Management Review*. (Spring 2002): 22-31.
- Christensen, C.M., and Raynor, M.E., 2003, *The Innovator’s Solution*. Boston (MA): Harvard Business School Press.
- Danneels, E., 2004, Disruptive Technology Reconsidered: a Critique and Research Agenda. *Journal of Product Innovation Management* 21: 246-258.
- Geroski, P., 1988, Thinking creatively about your market: crisps, perfume and business strategy. *Business strategy review* 9(2): 1-10.
- Gilad, B., 1996., *Business Blindspots* (2nd edition). Calne (GB): Infonortics.
- Govindarajan, V., and Kopalle, P.K., 2006a. The Usefulness of Measuring Disruptiveness of Innovations Ex Post in Making Ex Ante Predictions. *Journal of Product Innovation Management* 23: 12-18.
- Govindarajan, V., and Kopalle, P.K., 2006b. Disruptiveness of innovations: measurement and an assessment of reliability and validity. *Strategic Management Journal* 27: 189-199.

- Paap, J., and Katz, R., 2004, Anticipating Disruptive Innovation. *Research Technology Management* (sept-okt 2004): 13-33.
- Porter, M., 1985, *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: Free Press.
- Schmidt, G.M., and Druehl, C.T., 2008. When Is a Disruptive Innovation Disruptive? *Journal of Product Innovation Management* 25: 347-369.
- Stabell, C.B, and Fjeldstad, Ø.D., 1998. Configuring value for competitive advantage: on chains, shops and networks. *Strategic Management Journal* 19: 413-437.
- Thompson, J.D., *Organizations in Action*. New York: McGrawHill.