New Product Development

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Outline

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Key Words

Blue Ocean Strategy, Concept Testing, Customer Empowerment, Diffusion of Innovation, Disruptive Technology, Innovation, Idea Generation, Ideation Templates, Lead Users, Mass Customization, New Product Development, Non-Traditional Marketing, Preference Measurement, Sticky Information, Viral Marketing.

Abstract

We review a selected set of tools and frameworks for *customer-centric* new product development. We structure our review around the typical steps of the new product development process: opportunity identification, idea generation, design, testing, and launch. The list of topics addressed in this chapter is by no means exhaustive. We focus on topics which tend to be more recent and to present opportunities for further development and research.

1. Introduction

A new product may be viewed as a *solution* to a *need*. Successful products are those that provide elegant and efficient solutions to strong customer needs. Why do so many products fail to satisfy these conditions? An answer may be found in Eric von Hippel (1994)'s "sticky information" framework, which will be relevant throughout this chapter (see Figure 1). In order to develop elegant and efficient solutions to strong customer needs, two different types of information have to be combined: "need information" (what users need) and "solution information" (how products are built). The value of a new product is a function of the quality of the solution that it offers and of the relevance of the needs that it solves. Need information and solution information have two important characteristics in common, which may be viewed as the cause of many challenges in new product development: (1) need information and solution information reside in two different locations: users are by definition the proprietors of the former, while designers and manufacturers are usually the experts in the latter, (2) need information and solution information are "sticky," i.e., they are hard to translate and transfer between these two locations: it is difficult for manufacturers to extract need information from users, and customers usually do not have the expertise or the motivation to understand the solution information owned by companies. Without this fundamental information transfer issue, innovation would be a much less risky endeavor. Indeed, if manufacturers could understand their users' needs precisely and with little effort, it would be easy for them to develop relevant and useful products. Reciprocally, if users were able to become experts in how to address their own needs, they could develop such products themselves.

The "sticky information" framework will be relevant throughout this chapter. We review a selected set of tools and frameworks for customer-centric new product development. We structure our review around the typical steps of the new product development process: opportunity identification, idea generation, design, testing, and launch. The list of topics addressed in this chapter is by no means exhaustive. We focus on topics which tend to be more recent and to present opportunities for further development and research.

It is important to note that while we use the generic term "products" throughout the chapter, most of the tools and frameworks reviewed here apply to products as well as services, and to business to business as well as business to customer industries. It is also important to realize that while structuring the new product development process around a set of well-defined and rigorous steps presents many benefits, this process should be viewed more as a set of guidelines than as a set of rigid rules. In today's fast moving markets, new product development teams often need to be flexible enough to respond to unplanned changes in the environment.

<div align="center">INSERT FIGURE 1 ABOUT HERE</div>

2. Opportunity Identification

The first step of our typical new product development process is the identification of one or many opportunities. In some cases, the new product development team may enter the process with a specific new product idea, and may feel that this step is not required. However, even in such cases we strongly recommend taking the time to understand precisely the opportunity captured by this idea.

2.1. Observational research and beyond

Observational research is a fruitful source of opportunities. Observe your customers in their natural environment. How do they use your products and your competitors' products? Which features are they using, and how? What is missing in your products? For example, Lenovo^{TM} used this approach to identify innovation opportunities in the laptop computer market. A team followed laptop users in their offices, at home, in airports and other public places. They observed that users frequently drop their laptops, resulting in loss of data. This observation suggested an opportunity for a system akin to an airbag that would prevent laptop from shocks. It gave birth to the Active Protection System^{TM}. This system detects sudden changes in motion and temporarily stops the hard drive to help protect valuable data from the crashes that occur due to everyday notebook accidents.

Today, with the amount of customer interactions taking place online, it is possible to perform "observational" research without even observing the physical behavior of

customers. Online communities, in particular, are a great source of insights as they represent the voices of a large number of customers who freely express their views on current products. For example, iRobot® identified the opportunity for the Roomba® Scheduler directly from customer feedback on their Yahoo! User group. The second generation of the Roomba® included the capability for the Roomba to return to a docking station when the battery was dying so it would recharge itself. After the launch of the product, the iRobot® team monitored the Yahoo! group (over 8,000 users) dedicated to the Roomba. By participating in the user group and starting discussions with customers, the team noticed that Roomba® owners kept mentioning that it would be great if it would automatically go out and clean in addition to automatically returning when the battery needed charging. As a result, the team had the insights to create the Roomba® Scheduler, which allowed users to program up to seven scheduled cleaning times into the robot.

One of the benefits of observational research is that it allows the new product development team to understand the customers' experience with a given product. This benefit may be taken even further by having the new product development team "live" like customers. For example, Intuit developed the "Quickbooks Challenge" to ensure that its employees truly experienced the life of a customer using the Quickbooks software. Intuit took actual documents from a small business and tasked employees to take the documents and buy, install, and use Quickbooks software and services to complete certain tasks over the course of two days. With only two calls for help, each participant went through the same experience that a small-business owner would have with the product.

2.2. Blue Ocean Strategy

Kim and Mauborgne (2004, 2005)'s "Blue Ocean Strategy" framework may be used as a source of opportunities. Kim and Mauborgne document how various companies successfully created "blue oceans" of uncontested market space. These companies, like Cirque du Soleil or [yellow tail]® were able to make their competition irrelevant, to create new demand, and to lower their costs while increasing perceived customer value. They achieved the latter by changing the demographics of their target customers (e.g., Cirque du Soleil was able to increase the price of its performances by targeting adults and

corporate clients instead of the traditional circus customers), and adjusting the offer to these new customers (adults and corporate clients do not value animal acts as much as children – therefore this costly component of the circus may be abandoned when serving these new customers, without decreasing the value derived from the product).

We argue that two major types of "blue oceans" may be identified. See Table 1. "Between market" blue oceans target customers who find themselves over-served by the current high end of the market but underserved by the low end. These customers are not fully satisfied by the products they are currently using and would be willing to upgrade, however they only value a subset of the characteristics of the higher-end products, which is not enough to justify the price premium. For example, Southwest Airlines was able to capture customers "between" the market for driving and the market for flying. These customers valued the speed of flying, but did not value many of the other features offered by traditional airlines (e.g., lounges, flexible frequent flyer programs, extensive service, etc). Southwest created an airline that only offered the benefits truly valued by these customers, offering them the speed of flying at a cost close to driving.

"New market" blue oceans, on the other hand, target customers who are outside of the traditional market for the product. These customers are currently using very different products to satisfy needs that have some fundamental similarities with the needs addressed by your product. For example, Cirque du Soleil targeted adults and corporate clients who consumed the opera, Broadway shows, and the theatre to satisfy a need that is fundamentally comparable to the need addressed by the circus, the need for entertainment.

INSERT TABLE 1 ABOUT HERE

Once these two types of blue oceans have been identified, it becomes easier to develop the following practical guidelines for identifying "Blue Ocean" opportunities:

1. Identify the key features that define your product category and on which you tend to compete.

2. Identify a group of customers who value only a subset of these features. In the case of a "between market" blue ocean, look for a group of customers who are currently using lower-end alternatives but value some of the features of the higher-end alternatives. In the case of a "new market" blue ocean, look for a

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group of customers who are completely different from your current customers, but have needs that are similar at some fundamental level.

3. Make your product *worse* on the dimensions that are less valued by the group of customers that you have identified. This step is counterintuitive, but it is necessary in order to decrease your costs.

4. If possible, make your product *better* on the dimensions that are highly valued by your new target customers. In addition, introduce new features / dimensions designed specifically to please these new customers.

Let us illustrate these guidelines with the example of [yellow tail]®. This company developed a "between market" blue ocean by following the above steps: (1) wines traditionally compete, among others, on aging quality, vineyard prestige, and complexity. (2) [yellow tail]® identified a significant group of customers who were intrigued by wine, but who were intimidated by the difficulty of selecting and enjoying this product. These customers were typically reverting to beer as a lower-end alternative. (3) [yellow tail]® developed a line of wines that were worse than even the lower end of the market on the traditional dimensions of competition identified in step 1. (4) [yellow tail]® introduced new features / dimensions that were not traditionally used to evaluate wine, but that were valued by their target customers, such as "ease of drinking," "ease of selection," and "'fun." These new dimensions enabled the company to steal customers from the beer market.

Another practical approach to the creation of blue oceans, identified by Kim and Mauborgne, is making a functional product emotional, or an emotional product functional. Examples in the first category include Starbucks or the iPod, and examples in the second category include the Body Shop.

An interesting issue with blue ocean products is pricing. Blue ocean products often do not compete with products that share similar physical characteristics, but rather with products in different categories that serve similar needs, and therefore they are priced against these products. For example, Cirque du Soleil does not compete with circus as much as it competes with more sophisticated theatrical experiences (opera, ballet, Broadway shows, etc), and it is priced accordingly. Similarly, [yellow tail]®, at

least initially, did not compete with wine as much as it competed with beer, and priced its products against a six-pack of beer.

2.3. Disruptive Technology

Christensen (1998)'s impactful research on "Disruptive Technology" may also be a source of opportunities. We summarize the basic framework in Figure 2.

INSERT FIGURE 2 ABOUT HERE

Christensen observed that in a wide range of markets, including markets driven by technological innovations, established companies have a tendency to "overshoot" the needs of their main customers by offering products that are too sophisticated, too complex, and that achieve a performance level higher than necessary. This creates an opportunity for disruptive technologies that initially perform worse than established technologies on the key performance dimension, but that improve through trial and error and technological improvements, to the point where they are able to satisfy the main market (point A in Figure 2). At this point, mainstream customers naturally switch to the new technology and the established technology is disrupted. Note that in the initial stage (before point A), the new technology is not acceptable to the main market. Therefore it needs to find early adopters outside of this market. In order to convince early adopters to use an inferior technology, other benefits need to be offered. Christensen and Raynor (2003) made a distinction between two types of disruptive technologies, based on the benefit offered to early adopters. "Low-end disruptions" attract early adopters because of their lower price point. Early adopters of these technologies are at the lower end of the market, and cannot afford the established technology. Examples of such disruptions include ink jet printers, which perform worse than laser printers on the primary performance measure of resolution, but are offered at a lower price point. "New market disruptions," on the other hand, are not cheaper than established technologies, but offer a new, unique benefit. Their early adopters derive enough value from this new benefit to tolerate a lower performance on the traditional dimension. Examples of such technologies include cell phones, which were initially much more expensive than land line phones and had a worse reception quality, but offered a mobility benefit which was highly valued by their first adopters. Now that cell phones are comparable to land line phones in terms of

reception quality, a growing number of customers have switched completely from land lines to cell phones.

When searching for opportunities, the new product development team may attempt to identify markets that are ripe for disruption, i.e., markets in which established players have been overshooting the needs of their customers. The team may then explore ways in which these markets may be disrupted, using a "low end" or a "new market" approach.

An interesting feature of Christensen's framework is the tendency of established players to overshoot the needs of their markets. Is such behavior "irrational" or is it the result of profit-maximizing behavior? Some of the underlying reasons for overshooting may include the fact that high performance signals the competence of the firm, that markets are heterogeneous and that there always exist customers who demand higher performance, and that it is simply the job of R & D engineers to develop technologies with cutting-edge performance. Another interesting question, which may be addressed in future research, is whether overshooting is necessary for disruptions to take place. Can a technology be disrupted even if it does not overshoot the need of its customers? The answer is probably yes, if the new technology is cheaper and/or provides additional benefits. However, one may hypothesize that in such situations, the incumbent companies are less likely to be disrupted and driven out of business by the new technology. Indeed, the fact they do not overshoot the needs of their customers may be a sign that they are in touch with their markets, and the fact that they are not over-investing in the current technology should help them adapt quickly to the new, disruptive technology. This may explain for example why many of the major players in the land line phone market were able to retain their leading positions in the cell phone market. A similar argument may apply to film versus digital cameras. We hope that such hypothesis will be refined and tested in future research, and more generally that more work will be conducted to examine the boundaries of Christensen's framework.

It is also interesting to contrast and compare the disruptive technology framework with the blue ocean strategy framework. In both frameworks, a new alternative is introduced to the market that performs worse than existing alternatives on the primary performance dimension. However, a few differences are worth noting between the two

frameworks: (1) Christensen's framework assumes that the performance of the new technology improves with time; in contrast, blue oceans products do not need to improve with time in order to capture market share. (2) The customer base of a disruptive technology evolves to first include customers outside of the main market, and then includes customers in the main market (after point A in Figure 2). In contrast, the creation of a blue ocean does not require an evolving customer base, and customers of blue ocean products often do not include mainstream customers of the original product. (3) Christensen's framework captures performance as a unidimensional measure, whereas Kim and Mauborgne's framework relies on the multidimensional aspect of performance. In particular, blue ocean companies compete with established companies on some dimensions, consciously under perform on others, and introduce new dimensions.

We close by noting that the term "disruptive technologies" is often given a meaning that is not consistent with Christensen's original definition. In particular, it is important to realize that according to Christensen's definition, disruptive innovations are not the same as radical innovations. For example, DVD players were a radical innovation that was *not* disruptive (picture quality was better than VCR from the beginning), and the hard disk drive industry saw a succession of disruptive innovations that were not radical (Christensen 1998).

2.4. Lead users

Von Hippel (1986, 1988)'s research suggests an alternative source of opportunities: lead users. Von Hippel observed that many industrial and technological products have been developed historically by users rather than by companies. For example, Linux was developed when Linus Torvalds, then a computer science student in Finland, was frustrated as he was unable to run Unix on his personal computer. As suggested by the well known adage "necessity is the mother of innovation," users like Linus Torvalds innovate because they are dissatisfied with the options offered by the market, and because they have strong needs that justify investing in developing their own solutions. The lead user approach provides companies with a structured way of mining and leveraging user innovations, by involving lead users in the new product development process. Formally, lead users are defined by two characteristics: (1) they have needs that

foreshadow general demand in the market place: their needs today are the market's needs of tomorrow. (2) they expect to obtain a high benefit from a solution to their extreme needs. Von Hippel shows that users who satisfy these two characteristics are the most likely to have developed innovative solutions, which may be turned into successful commercial products.

The unique features of the lead user approach are best understood within the "sticky information" framework introduced earlier. In particular, while users are typically a source of need information and are not expert in solution information, lead users are an exception: they have developed their own solution information, and their needs are less relevant to the new product development team as they are not representative of the main market. In other words, while the traditional way of involving users in new product development is for the manufacturer to extract need information from its users and to use its expertise to develop a solution to these needs, the lead user approach allows uncovering, encouraging and commercializing solutions developed by a special type of users.

It is important to realize that lead users are not necessarily users of your products, and are not even necessarily in your target market. Moreover, lead users may be individuals as well as companies or any other organization. Consider the example of Nortel networks. When attempting to innovate in wireless internet applications, a Nortel networks team identified mobility as the need to be solved. They found lead users who had faced extreme versions of this need in fields as diverse as battlefield operations, storm chasing, animal tracking and law enforcement.

Applying the lead user approach is neither easy nor inexpensive. Identifying lead users often involves extensive interviewing and networking, and allowing these lead users to interact with each other and with the company typically requires the organization of workshops. Therefore, we believe that this approach should be reserved for situations in which the company has already identified a need to be solved, but has not been able to develop an efficient and elegant solution to this need. It would be unwise and counterproductive to use the lead user approach to identify new needs (recall that lead users have needs that are not representative of your customers).

We close by noting that the lead user approach has gained even more relevance in the recent years, with the emergence of a wide range of communities of innovative users. These communities of users who usually share their innovations online may be viewed by some companies as a threat, as their innovation capabilities often surpass those of the best R&D departments. However they may also be turned into an invaluable resource. For example, only 3 weeks after the release of the first Lego® Mindstorms®, 900 "hackers" had reverse engineered the robots, improved them, and shared their innovations online. After a period of hesitation, the company decided to embrace user innovations, and to involve these expert users in the development of the subsequent versions of the product. Eric von Hippel has argued that in the future many companies will act primarily as "publishers" of user innovations.

2.5. Market segmentation

Sometimes, interesting opportunities may emerge by simply segmenting your market. Christensen, Cook, and Hall (2005) recently proposed a compelling way to segment markets which works particularly well with opportunity identification. These authors argue that markets should be segmented based on the "jobs" that customers hire the product to perform. They give the example of milkshakes, which they have found to be "hired" by two very different segments of customers to perform very different jobs. The first segment is composed of commuters who hire milkshakes as a source of entertainment during their long commute. This segment values the ease of use of the milkshake (consumption only requires one hand and is clean), and its viscosity (the more viscous, the slower the consumption, the longer the milkshake will keep them busy). The second segment is composed of parents who hire milkshakes in the evening as a treat for their children (after saying "no" to them all day). These customers value the taste of the milkshake, but do not value its viscosity (for these customers, slower consumption means waiting longer for their children to finish their meals). Once the market is segmented in this fashion, it becomes obvious that your real competitors are often completely different products in very different markets. In our milkshake example, competitors for the first segment include bananas, snack bars, and listening to the radio, and competitors for the second segment include toys and movies.

Once your market has been segmented based on the jobs that your products are hired to perform, opportunities may be identified by answering the following questions:

- Can we modify our product so that it will perform the job(s) better?
- Can we develop a completely different product that will perform the same job(s) more efficiently?
- If our product is currently used by different customers to perform different jobs, can we develop multiple versions of the product for each job?
- Can we identify customers who are different from our current customers but who hire a different product to perform a similar job? If so, can we modify our product to serve these customers? Note here the similarly with the blue ocean framework (the core customers of Cirque du Soleil, for example, were hiring non-circus alternatives to perform the job of entertainment).

It is also important to note that the "jobs" to be performed may also be described as needs. Therefore a link may again be made to the "sticky information" framework, as one may argue that Christensen, Cook, and Hall (2005) suggest segmenting customers based on their need information.

2.6. Mass customization

Offering a mass customized version of an existing product or developing a new mass customized product may also be a valid opportunity. Mass customization has become pervasive in the past few years. Some examples include customized cars (e.g., Toyota's Scion), shoes (e.g., NIKEiD, Adicolor by Adidas®), Toys (e.g., Lego® Factory), T-shirts (e.g., Spreadshirt), candies (e.g., M&M's, Hershey's), cereal boxes (e.g., Wheaties), condiments (e.g., myheinz.com), and soda bottles (e.g., myJones).

Given its ubiquity, it is crucial to develop a framework for approaching mass customization. Such a framework has been proposed by Gilmore and Pine (1997) who identified four types of mass customization:

- *Collaborative mass customization.* This is the most common approach, in which a product is customized through a dialogue (usually online) between the customer and the manufacturer. Typical examples of this approach include Dell computers.

- *Adaptive mass customization.* This approach consists in offering a uniform product that users customize themselves. One example is Adidas' Adicolor kits that included a pair of white shoes, a set of paint tubes, brushes and an easel. Users were able to decorate their shoes to their own taste.

- *Cosmetic customization.* This approach consists in presenting a standard product differently to different users. One example is The Planters Company, which sells the same product (peanuts) in different packaging based on the retailer's request.

- *Transparent customization.* This approach consists in customizing products based on observing the customer's past behavior, instead of directly requesting input from him or her. Examples include checkout coupons and online recommendations provided by retailers such as amazon.com.

We have found Gilmore and Pine's framework useful for exploring various mass customization options and going beyond the most common approach of collaborative customization. However this framework is not without its own limitations. For example, are digital video recorders a case of collaborative or adaptive mass customization? If one focuses on the devices installed in the user's home, then the approach is probably adaptive (all users get the same device but use it differently). One the other hand, if one focuses on the TV programs viewed by the user, then the approach is probably collaborative (the user customizes his or her TV programs through interactions with the service). We hope that future research will propose additional frameworks for mass customization. We believe that the "sticky information" paradigm may be relevant here again. In particular, mass customization may be viewed as changing the way information is transferred between users (who own need information) and manufacturers (who own solution information). When developing non-customized products, manufacturers typically collect need information from a group of users, aggregate this information and use their solution expertise to develop one or a few solutions. Mass customization allows exploring alternative flows of information. For example, with collaborative customization, manufacturers can extract individual need information and develop solutions for each user without aggregating this information; with adaptive customization manufacturers transfer solution information to users and let them use their need information to develop

their own solutions; with transparent customization, manufacturers are able to extract need information implicitly by observing the behavior of their customers.

We close by noting additional benefits offered by mass customization as well as some additional challenges. Benefits include reducing double marginalization issues by selling directly to the end user, reducing the effects of waste aversion (mass customization allows customers to pay only for the features they need, therefore reducing perceived waste), and serving a need for uniqueness (many customers are willing to pay a premium for products that allow them to express their uniqueness). On the other hand, Zipkin (2001) cautions that mass customization is not appropriate for all products and industries, and identifies some important limits of mass customization. In particular, mass customization requires a highly flexible production process, a system for eliciting customers' unique needs, and a strong direct-to-customer logistics system. Moreover, there are many markets in which customers are not willing to pay a high premium for customized products.

3. Idea Generation

Once an opportunity has been identified, the next step is typically to generate specific ideas on how this opportunity may be pursued. The best known idea generation methods have evolved from "brainstorming," developed by Osborn, an advertising executive, in the 1950's (Osborn 1957). Brainstorming is based on the assumptions that everyone can be creative, that generating ideas in groups allows synergies between participants, that ideas should not be judged until the end of the generation exercise, and that as many ideas as possible should be generated to maximize the number of good ideas.

Surprisingly, despite the widespread adoption of the method, dozens of studies have demonstrated that groups generating ideas using traditional brainstorming are less effective than individuals working alone (see for example Diehl and Stroebe 1987 for a review). Three main explanations have been provided for the poor performance of idea generation groups: fear of evaluation, free riding, and production blocking. Fear of evaluation refers to the participants' fear of negative evaluations by others. Free riding is a classic effect in group tasks in which the participants are not rewarded for their individual contributions: participants have a tendency to rely on the other members of the

group and do not exert an optimal level of effort. Production blocking follows directly from the fact that in a face-to-face group, participants are not always able to express their ideas as they come to mind because only one member can speak at a time.

An important attempt to leverage group synergies while limiting productivity losses has been the development of Electronic Brainstorming, or EBS. Participants access EBS sessions through a network of computer terminals. They enter ideas into their terminals and download other participants' ideas at their own pace. Moreover, the identity of the author of each idea is concealed. EBS has been shown to reduce production blocking, fear of evaluation, and perceptions of free riding (see for example Cooper et al., 1998; Dennis and Valacich, 1993; Gallupe et al., 1994; Valacich, Dennis and Connolly, 1994). However, while EBS has been shown to be an improvement over traditional brainstorming, comparisons of groups versus individuals have been mixed. Using EBS, interacting groups of size larger than or equal to 9 have been shown to perform better than individuals working alone. However, interacting groups of size smaller than or equal to 8 have been shown to perform at best similarly to individuals working alone (see for example Dennis and Valacich, 1993).

3.1. Customer empowerment

Companies increasingly involve their own customers in the idea generation phase of the new product development process. It is important to understand the different ways in which customers may be involved so early in the process, what can be expected from them, and how to best engage them. Fuchs and Schreier (2007) proposed an interesting framework for approaching customer empowerment. See Figure 3. The two relevant dimensions proposed by the authors are whether customers are given the power to suggest new ideas, and whether they are given the power to screen these ideas.

INSERT FIGURE 3 ABOUT HERE

Customer empowerment is not without issues. One first issue is that customers, because they do not work for the company, do not have any formal incentive to help generating new and better ideas, which exacerbates the free riding problem reviewed above. In order to address this issue, Toubia (2006) proposed an online "ideation game" that makes idea generation fun, convenient and competitive. Participants score points not

only for submitting ideas, but also for the impact of their ideas on the other participants. These points may be redeemed for monetary or non-monetary rewards. Toubia showed that such incentives have the power to enhance the output of idea generation sessions.

A second issue is that involving a large number of customers in idea generation often gives rise to a very large number of ideas (hundreds or even thousands). The new product development team is then left with the daunting task of screening these ideas in order to focus its limited resources on those with the highest potential. One traditional approach to idea screening is to ask one or a few experts to go over the transcripts of ideas and evaluate them. However, after establishing a connection with customers at such an early stage of the new product development process, it may be preferable to maintain this connection by allowing customers themselves to identify the best ideas. Toubia and Florès (2007) proposed an online adaptive idea screening tool for involving customers in idea screening. Instead of asking a few experts to each evaluate many ideas, this tool asks many customers to each evaluate a few ideas selected using an adaptive algorithm. While Toubia and Florès focus on the methodological issues with involving customers in idea screening, we hope that future research will further explore the fundamental qualitative differences between consumer screening and expert screening. Recall that the best ideas propose elegant and efficient solutions to strong customer needs. Based on the "sticky information" framework, we expect experts to have a tendency to evaluate an idea based on the elegance and efficiency of the proposed solution, and customers to evaluate an idea based on the strength of the need that it addresses.

We close with the issue of selecting the appropriate type of customers to involve in idea generation and idea screening. For example, should firms involve lead users or "average" customers? We believe that the answer to this question depends on whether the company is seeking customers' help to identify new needs or to develop new solutions. In the first case, average customers should be involved as their needs are representative of the market. In the second case, lead users should be involved as they have developed unique and novel solution information. It is usually unrealistic to expect average customers to offer innovative solutions, and it is unwise to use lead users as a source of need information. See Figure 4.

INSERT FIGURE 4 ABOUT HERE

3.2. Ideation templates

We now review an ideation technique that is counter-intuitive and yet very effective, the ideation templates (Goldenberg et al. 1999a, Goldenberg and Mazursky 2002, Goldenberg et al., 2003). This approach, unlike traditional approaches such as brainstorming, is based on a structured view of creativity, according to which the key to creativity lies in the identification and application of well-defined regularities or patterns (Goldenberg et al. 1999b). The ideation templates emerged from an in-depth historical analysis of thousands of past products. The rationale is that if successful past ideas are found to have a certain fundamental structure, then one should attempt to generate new ideas that reproduce this "winning" structure. This may be achieved by applying one or more of the following templates.

- *Attribute dependency template.* This template modifies existing relationships between attributes of the product and its environment. For example, before the introduction of rollover cell phone plans, the number of minutes available to a user in a given month was independent of the number of minutes used in the previous month. Rollover plans introduced a new relationship between these two attributes. The attribute dependency template may be applied using the following steps: (1) identify a list of *internal* attributes of the product, which are under the manufacturer's control. In the case of cell phones, for example, such attributes would include the ring tone, the speaker volume, the ringing style, etc. (2) identify a list of *external* attributes, which are outside the manufacturer's control but are in direct relation with the product. Such external attributes for a cell phone would include ambient noise, user's calendar, etc. (3) construct a "forecasting matrix" with the internal attributes as columns and the internal and external attributes as rows. See Figure 5 for an example of such a matrix. (4) For each cell of the matrix (except those on the diagonal), explore how the relation between the two corresponding attributes may be altered. The more fruitful cells are often those that explore how an external attribute may influence an internal attribute. For example, the matrix on Figure 4 may inspire ideas such as a having the ringing tone adapt automatically to the ambient noise (e.g., low pitch ringing tone if high pitch ambient noise, and vice versa), the speaker volume adapt to the level of ambient noise, the ringing style adapt to the ambient noise (switch to vibrating mode

if very high ambient noise, and possibly if very low ambient noise as well – as low ambient noise may indicate that the use of cell phones is prohibited), or synchronizing the ringing style with the user's calendar (e.g., switch to vibrating mode if the user is in a meeting or a class).

INSERT FIGURE 5 ABOUT HERE

- *Task Unification template.* This template assigns a task to an existing resource in the environment of the product. This task may be currently performed by a component of the product (in which case this component may be removed from the product), or may be a completely new task. This template forces the new product development team to view any component in the environment of the product as a possible resource. Consider for example recaptha™, used by web sites such as facebook.com and recommended as the official captcha implementation by the creators of captcha. (Captchas are tests that authentify web site visitors as humans. They usually consist in recognizing words with high levels of warping crossed by an angled line. Only humans have the ability to recognize such words.) Recaptcha™ has turned the existing use of human intelligence to solve the millions of captchas used by websites everyday as a resource for digitizing old books. Indeed, digitizing old books requires recognizing millions of words that are not recognized by today's most powerful pattern matching algorithms due to the poor quality of the book copies. Recaptcha™ has turned these unrecognized words into captchas. When being authenticated as real humans on a website, customers help recaptcha™ digitize old books!

- *Subtraction template.* This template removes an essential component of a product. While removing this component deprives the product from one its fundamental functions, it may create new benefits. For example, imagine a store with no check out counter, and in which no product is for sale. While counter-intuitive at first, such concept offers other benefits such as the ability to showcase products that are not available yet or that are available only in other geographical markets, and an improved customer experience free of impulse purchases. Such concept does exist; the Samsung Experience Store is one example.

- *Division template.* This template creates new benefits by separating the components of a product. Examples include the anti-theft car audio system: the anti-theft function is achieved by separating the front of the system from the base.

- *Multiplication template.* This template consists in creating new benefits by adding copies of a component of the product, which are slightly different from the original component. Examples include the four wheel carry on luggage. Adding two wheels at a new location and allowing all the wheels to rotate in all directions greatly enhanced the mobility of the luggage.

Note that while the attribute dependency template operates on the *attributes* of the product and its environment (e.g., screen size, speaker volume, age of the user, etc), the other four operate on *components* of the product and its environment (e.g., screen, speaker, user)

4. Design

The opportunity identification and idea generation stages of the development process usually suggest a set of rough product concepts. In the design stage, the new product development team develops a core benefit proposition for each of these concepts, agrees on a set of target customers and a positioning with respect to competition, develops a specific set of features, and starts making decisions pertaining to pricing and distribution. It is common to survey customers at this stage to understand and quantify their needs and preferences.

One first approach to surveying customers in the design stage is to use methods such as the "Voice of the Customer" (Griffin, and Hauser 1993) and the "House of Quality" (Hauser 1993). Through extensive one on one interviews and quantitative surveys, the "Voice of the Customer" methodology allows clearly identifying, structuring and prioritizing customers' needs. The "House of Quality" helps translating these needs into solutions (i.e., specific features of a product, software, etc) by summarizing on a single document the customer needs and their importances, the set of relevant design attributes, the relation between these attributes and the needs (i.e., whether each attribute contributes positively or negatively to each of the needs), the relation among attributes (e.g., whether increasing one attribute requires decreasing another), customers' current

perceptions of the company's products and its competitors, as well as additional engineering measures (see Hauser 1993 for an example). We believe that the "Voice of the Customer" and the "House of Quality" are most suitable in situations in which: (1) users have rich, complex and precise needs, (2) products are characterized by many features that interact with one another, (3) there is poor communication between the marketing, engineering and R&D functions. The "House of Quality," in particular, forces these functions to collaborate, to understand each other's language, and to realize the challenges faced by each division, (4) users are more comfortable talking about their needs than talking about solutions. Such condition is often satisfied in technology-intense markets when the translation problem between need information and solution information is exaggerated.

A second approach to surveying customers in the design stage is to quantify their preferences for the various features of a product (or service), using methods such as conjoint analysis. Conjoint analysis is probably the most widely used quantitative marketing research method. It provides a detailed, quantitative understanding of customers' preferences for features, enabling companies to design products that maximize expected profit. Note that while the "Voice of the Customer" approach surveys customers about their needs, conjoint analysis surveys them directly about their preferences for features (i.e., solutions). Therefore we recommend using conjoint analysis only in situations in which customers are comfortable talking about the product in "solutions" terms.

The internet has become the medium of choice for conjoint analysis. It is now possible and common to collect very large data sets at a reasonable cost. However online respondents typically have a lower level of involvement in the survey, which may lead to higher response error and lower completion rates (for a review see Crawfard, Couper and Lamias, 2001 or Couper, Blair and Triplett, 1999), and which limits the number of questions that may be asked to each consumer. For example, in what may become common practice, Research International recently performed a conjoint analysis study with 198,000 respondents answering short questionnaires from their cell phones. While the online environment accentuates the issue of consumer involvement, it also provides some unique benefits that may be leveraged to address that very issue. For example,

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computations may be performed during the task, allowing adapting the questionnaire to the respondent's previous answers. Adaptive methods include Adaptive Conjoint Analysis (ACA, Johnson 1987), the Fast Polyhedral approach (Toubia et al. 2003; Toubia, Hauser and Garcia, 2007; Toubia, Hauser and Simester 2004), and the Adaptive Self-Explicated approach (Netzer and Srinivasan 2007). Another way to improve customer involvement is to provide media-rich stimuli to the customers (Dahan and Srinivasan 2000). Finally, consumer involvement may be enhanced by replacing the commonly used hypothetical preference measurement questions with incentive-aligned tasks, in which respondents have to "live with" their decisions (Ding 2007; Ding, Grewal and Liechty 2005).

We hope that future research will further exploit the benefits of computerized preference measurement to develop new, engaging forms of interactions between firms and customers and between customers themselves. In particular, we expect to see an increase in the number of methods that turn preference measurement into fun and engaging games designed such that the optimal strategy for customers (i.e., the strategy that will win the game) involves truthfully revealing their preferences, thoughts or feedback. For example, Prelec (2001) proposed an online board game, the Information Pump, which extracts customers' reactions to new product concepts. Toubia (2006) proposed an ideation game in which participants are rewarded for generating useful new product ideas.

5. Testing

At the conclusion of the design stage, the new product development team has developed and refined one, and usually many, product concepts. In the Testing stage, the team will select the concept(s) most likely to be successful (concept testing), and possibly attempt to forecast sales for this(ese) innovation(s), using for example simulated test markets (Silk and Urban 1978). In this chapter we focus on concept testing, and refer readers to Clancy, Krieg and Wolf (2006) for a review of simulated test markets.

The traditional approach to concept testing is to present customers with a set of concept boards (one after the other), and to ask the following questions for each concept (the answers to the first four questions are typically provided on a 5 to 9 point scale):

"How likely would you be to buy this new product?"; "How much do you like this new product?"; "How would you rate this new product in terms of being new and different from other products available?"; "How do you feel about the believability of the statements made about this new product?". Today, concept testing is typically performed online, with the concept descriptions including a paragraph reflecting the benefit proposition and key features of the concept, and possibly a set of "lifestyle" pictures evoking the target segments and positioning. Companies typically screen concepts on the two main dimensions of purchase intent and uniqueness. Concepts high on these two dimensions are judged the most likely to succeed.

In the past few years, a new method has emerged for concept testing, using simulated stock markets. Stock markets, or prediction markets, have been used successfully in several areas beyond finance. For example, the Iowa Electronic Market and Intrade™ use stock market mechanisms to predict the outcome of elections and other political events. The Hollywood Stock Exchange® hosts stock markets for movies and movie stars. Yahoo!® Research and O'Reilly ® have developed a stock market of new technologies, in which the dividends on each stock are based on the search volume for the corresponding technology on the Yahoo!® search engine. The use of stock markets for concept testing has been of growing interest to academics (Dahan, Lo, Poggio, Chan and Kim, 2007) and practitioners. A growing number of software and consulting companies now host such markets, in which one stock is created for each new product concept, and employees or customers trade "concept stocks" based on their expectations of the quality and potential of these concepts. The winning concepts are typically those with the highest stock prices. Despite the growing popularity of this application of stock markets, we feel that more research is required to test their validity and to identify conditions under which they are most likely to be useful. For example, it is not clear how the outcome of a concept stock market differs from that of simply asking participants to allocate 100 points across concepts. In particular, while in financial markets stock prices fluctuate to reflect new information (earnings, etc), it is not clear what drives variations in prices when stocks represent hypothetical concepts that have not been fully developed and that are not commercially available yet. It seems that the primary type of information acquired by traders as a concept stock market progresses is the behavior of the other traders.

Therefore, one may hypothesize that concept stock markets are most suitable for products with network externalities, whereby each participant's valuation of a concept is a function of all other participants' valuations. It is also interesting to note that proponents of concept stock markets usually cite the best-selling book "Wisdom of Crowds" (Surowiecki 2004) as support for the approach of aggregating the opinions of many "average" participants. Indeed, Surowiecki shows that under a specific set of assumptions, a large number of non-experts may collectively make better judgments and predictions compared to a small number of experts. However, one of these conditions is that the judges be independent, i.e., not influenced by one another. One should be aware that this condition is violated in concept stock markets.

Looking further into the future, the emerging field of neuromarketing may have the potential to revolutionize concept testing. In their ground breaking paper, McClure et al. (2004) revisited the Coke versus Pepsi challenge using fMRI (functional Magnetic Resonance Imaging) technology to observe the brain's response to decarbonated squirts of Coke and Pepsi dispensed to participants through a pacifier. They found that the brain's relative activation for Coke versus Pepsi was correlated with the choice made by the participants in a blind taste test performed outside of the fMRI machine. In other words, they showed that it is possible to predict whether a consumer would prefer Coke or Pepsi based on observing his or her brain's reactions when sampling each beverage. Moreover, the authors showed that the brain response was very different when participants were aware of whether they were drinking Coke or Pepsi. In particular, the knowledge that they were drinking Coke activated parts of the participants' brains involved in high-level cognitive processes such as emotions, affect and memory. This suggests that the "Coke" brand itself is able to provoke a response that goes beyond the physical characteristics of the products sold under the brand. The "Pepsi" brand, on the other hand, did not provoke such a response in the participants' brains. While the field of Neuromarketing is still nascent, we hope that future research will explore its use in concept testing. In particular, while McClure et al. (2004) were able to show that the use of neuroimaging resulted in predictions that were similar to those of a blind taste test, Neuromarketing will have to offer *new* or *better* insights in order to justify its higher cost. We expect that some benefits may come from the understanding of the process through

which customers evaluate and choose products, and/or from the reduction of some typical biases in marketing research, such as social desirability, demand effects and fatigue effects. On the negative side, fMRI does not currently allow observing customers in their natural environment.

6. Launch

The launch of new products involves a large number of critical decisions, pertaining for example to budget allocation, pricing, marketing planning, and distribution channels. In the interest of space and given our focus on customer-centric new product development, we limit ourselves here to non-traditional approaches to launch campaigns, and to models for forecasting the diffusion of an innovation.

6.1. Non-traditional launch campaigns

The past decade has seen the advent of "non-traditional" approaches to the launch of new products. Non-traditional marketing has become so wide spread that it is often not viewed as "non-traditional" anymore. For example, the product placement industry alone was estimated at $2.2 bn in 2005, and $3.1 bn in 2006. We propose a framework for approaching non-traditional marketing, depicted in Figure 6. We believe that a first distinction may be made between product placements and branded entertainment on the one hand, and buzz and viral marketing on the other. We contrast these two approaches in Table 2.

Product placement consists in having products featured in movies, TV shows, video games, etc. Companies usually attempt to make the placement seamless, for example by ensuring that the product fits naturally with the plot of a movie. Branded entertainment refers to companies offering free entertainment to customers, often with no direct relation with the product or the brand. Examples include the BMW films, and Burger King®'s "subservient chicken." When executed correctly, product placements have the power to establish new associations in the consumer's mind, between the product or the brand and the character or actor using the product. In both cases of product placement and branded entertainment, "emotional" associations may also be created between the emotions evoked by the product or the brand and the emotions experienced

by the consumer when enjoying the relevant piece of entertainment. We hope to see more research exploring the process through which these associations are formed, as well as their long-term impact.

On the other hand, buzz and viral marketing are primarily centered on leveraging social interactions and word of mouth. Within this area of non-traditional marketing, we make a distinction between an active approach of creating word of mouth, and a passive approach of tracking natural word of mouth. The active approach usually involves giving free samples to influential customers (service offered by companies such as Bzzagent™, Tremor, and shespeaks[SM]), or hiring professional "agents" (service offered by companies such as Electric Artists or DMC). We hope that future research will further explore the sustainability and effectiveness of this active approach. On the other hand, the passive approach to buzz and viral marketing consists in observing conversations that are naturally taking place, primarily on the Internet. Two sub-approaches may be identified here again: a qualitative approach and a quantitative approach. The qualitative approach consists in gaining insights from reading, analyzing and mining discussion boards, blogs, forums, review sites, newsgroups, etc. This approach has been dubbed "netnography" by Kozinets (2002), and is commercially available from companies such as Nielsen BuzzMetrics, cymfony, and clarabridge™. The quantitative approach consists in collecting various metrics on specific keywords. For example Google™ Trends allows tracking the search volume on Google™ for specific phrases, and Technorati™ and Blogpulse™ allow searching for the number of blog posts containing those phrases. Such signals may be used to track, analyze and even forecast the diffusion of a new product. In particular, Godes and Mayzlin (2004) were able to predict future ratings of new TV shows by simply counting the number of messages mentioning each show on several Usenet newsgroups. More precisely, they found that while the mere number of messages mentioning a show did not provide any predictive power above and beyond the show's previous week rating, the number of different groups in which the show was mentioned was a good predictor of the show's future ratings. In other words, Godes and Mayzlin showed that the *dispersion* of conversations across communities is a greater driver of diffusion than the *volume* of these conversations.

INSERT FIGURE 6 ABOUT HERE

Of course, the limitations of non-traditional launch campaigns should not be overlooked. For example, product placements and branded entertainment often allow conveying only limited specific information about products to customers. The effectiveness of this approach is also hard to measure using current tools. Moreover, product placements are often characterized by a lack of control over the way the product is portrayed, are risky as there is no guarantee that the movie, TV show or video game will reach a broad audience, and may backfire, for example if the integration is not seamless. It is also interesting to note that in a 2007 study conducted by Mediapost and Dynamic Logic, 50% of marketing and advertising professionals described viral marketing as more of a fad than a widely available tactic.

6.2. Diffusion of Innovation

It is critical to monitor and forecast the diffusion of a new product after its launch, for example to adjust the launch plan or the marketing mix, or to time the development of the next product generation. Two sets of methodologies have emerged in the large literature of Diffusion of Innovation: aggregate (market-level) approaches and disaggregate (individual-level) approaches.

Aggregate models forecast the diffusion curve without a direct derivation of an individual's adoption decision. The Bass model (Bass 1969) and its variants are the most prominent models in this stream of research. The basic Bass model captures two drivers of the adoption of a new product category by customers: "external" marketing forces (such as advertising), represented by a parameter p^{Bass}, and "internal" social interaction (or word of mouth) effects, represented by a parameter q^{Bass}. The model is:

$\frac{S_{t+1}}{m} = \frac{S_t}{m} + (p^{Bass} + q^{Bass}\frac{S_t}{m}).(1-\frac{S_t}{m})$, where S_t is the cumulative number of adopters by the end of period t, and m is the total market potential. This model has been extended for example to account for non-uniform influence of adopters on non-adopters over time (Easingwood, Mahajan, Muller 1983), asymmetric influence between different segments of potential adopters (Muller and Yogev 2006, Van den Bulte and Joshi 2007), and heterogeneity across potential adopters (Karmeshu and Goswami 2001). The Bass model and its variants are typically applied to product categories as opposed to specific

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products, and calibrated based on past aggregate penetration data. These aggregate models are parsimonious and usually fit observed historical diffusion curves fairly well. However, they are not as useful for *predicting* the diffusion of an innovation shortly after its launch, when the faith of the innovation is most uncertain and forecasts are most critical.

Disaggregate models study the diffusion of an innovation using the individual customer as the unit of analysis. One class of models within this category is Bayesian learning models (Chatterjee and Eliashberg, 1990), in which customers adopt an innovation if its expected benefit is high enough relative to its price and to the uncertainty on its performance. Such models have been found to be advantageous because they can be grounded in consumer behavior theory, and take into consideration heterogeneity in consumer choice decisions. However, the number of parameters required to fully capture the adoption process may be very large, and calibrating these models to forecast the entire diffusion process of an innovation is usually intractable.

Another class of disaggregate models are agent-based models (Garber et al., 2004; Goldenberg et al., 2002). These models capture similar "internal" and "external" forces as the Bass model. One of their advantages is that they allow capturing a wide range of alternative assumptions on the diffusion process, such as various network effects or the existence of influential customers. However, one of their current limitations is that the aggregate diffusion process is not available in closed form. Instead, inference has relied on computer simulations that require using specialized software and setting several parameters exogenously (e.g., size and structure of the customer network), allowing multiple factors to influence the results. Because of all these limitations, the use of agent-based models is not recommended for forecasting the entire diffusion process of an innovation.

Recently, Toubia, Goldenberg and Garcia (2008) attempted to combine the benefits of aggregate and disaggregate diffusion models while avoiding most of their respective shortcomings. They proposed a class of aggregate diffusion models motivated by agent-based models. These models allow capturing assumptions (or combinations of assumptions) on the diffusion process that are not traditionally captured by extant aggregate models, such as heterogeneity in the number of social ties. Moreover, these

models may be calibrated shortly after launch using a combination of aggregate penetration data and disaggregate survey data.

7. Conclusion

We have reviewed and attempted to put in perspective a selection of tools and frameworks pertaining to each step of a typical new product development process. These tools and frameworks have themselves been enabled by theoretical and technological advances in a variety of fields. Technological advances in supply chain management and logistics have made mass-customization widely accessible. Advances in medical imaging have made it possible to envision a future in which companies will be able to use neuroimaging in new product development. Advances in information technology have opened the door to new forms of interactions between customers and firms and between customers themselves, revolutionizing observational research, enabling companies to empower their customers early in the development process, and giving rise to fun and engaging preference measurement and concept testing methods. A better understanding of the process of customer interactions has given rise to new launch tools that leverage social interactions and to new models for forecasting the diffusion of an innovation. The historical analysis of successful companies and innovators has given rise to powerful frameworks and methodologies such as Disruptive Technology, Blue Ocean Stragegy, Lead Users and the Ideation Templates.

As Science, Society and Technology continue to evolve, we have all reasons to believe that innovations in the field of innovation will continue to blossom.

Glossary

Core Benefit Proposition: short statement (preferably one sentence) summarizing the key benefits customers should expect from buying a product.

Customer-Centric New Product Development: aspects of new product development that revolve around customers and their needs, as opposed to technological developments.

Demand Effects: in marketing research, demand effects refer to a tendency by customers to provide a response that they believe to be expected by the researcher.

Double Marginalization: phenomenon that occurs when a wholesaler sells products to a retailer that in turn sells these products to the end customers. The wholesaler (retailer) sets the wholesale (retail) price to maximize its own profit. As a result, the total profit made by the wholesaler and the retailer is lower than what could be achieved by maximizing both profits jointly.

Emotional products: products that offer a clear and inherent emotional reward.

Functional products: products that typically do not embody any inherent emotional gratification. All the customer expects from such product is that it will do what it is supposed to do.

Mass-customization: using flexible computer-aided manufacturing systems to produce custom output. Those systems combine the low unit costs of mass production processes with the flexibility of individual customization.

Network Externalities: products with network externalities are such that the value derived from these products is increasing with the number of users (examples include fax machines and the telephone).

Observational Research: a social research technique that involves the direct observation of phenomena in their natural setting.

Product Positioning: aggregate market perception of how a given product relates to its competitors in the same category.

Radical innovation: innovation that involves completely new knowledge and/or resources, as well as large technological advancements.

Social Desirability Bias: the inclination to present oneself in a manner that will be viewed favorably by others.

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Tables

Table 1: two types of blue oceans

	"Between Market"	"New Market"
Customers	At the margin of the current market – currently using lower end alternatives	Consume very different products but have fundamentally similar needs as current customers
Product	Compromise between high-end and low-end alternatives	Tailored and adjusted specifically for new customers
Examples	Southwest airlines (between airlines and car)	Cirque du Soleil (circus for adults and corporate clients)

Table 2: product placement/branded entertainment versus buzz/viral marketing

	Product placement / branded entertainment	**Buzz marketing / viral marketing**
Key benefit	Create associations	Leverage word of mouth and social interactions
Content created and delivered by…	a company	other customers (supposedly)
Type of content	Multimedia, sensory, experiental	Primarily verbal
Information about specific product	Usually limited	Potentially rich

Figures

Figure 1: the "sticky information" framework

Manufacturers   **Users**

Solution   Need
Information   Information

new product = SOLUTION to a NEED
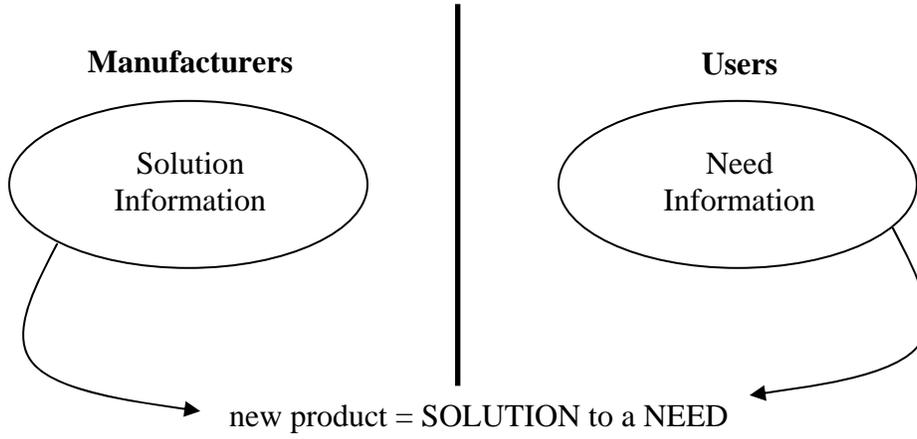
Figure 2: the basic Disruptive Technology framework

performance

performance of present technology

A

performance that customers
can absorb or utilize

performance of disruptive technology

time
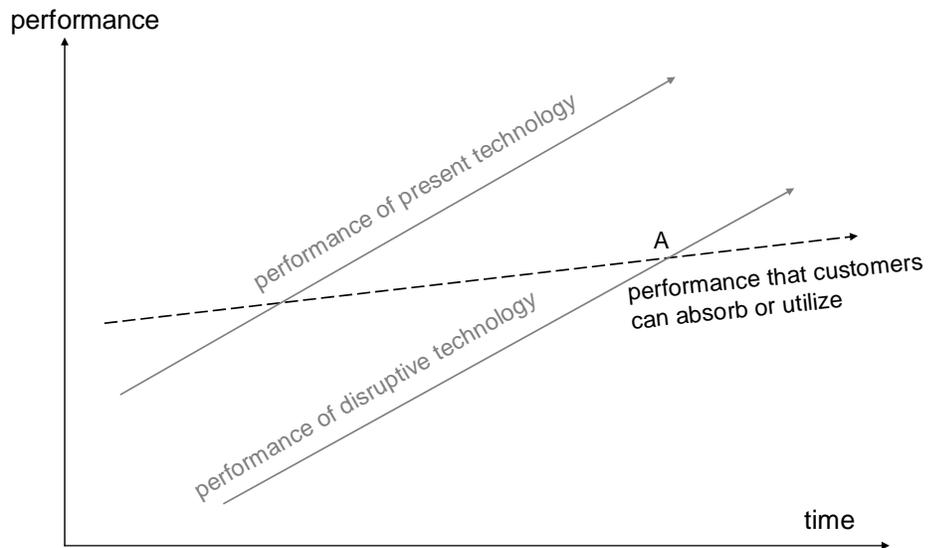
Figure 3: empowering customers in the early stages of new product development
(from Fuchs and Schreier 2007)

Who generates the ideas?

		Company (screens)	Customers (screens)
	Customers	"Create" empowerment	Full empowerment
	Company	No empowerment	"Select" empowerment

Company   Customers

Who screens the ideas?

Figure 4: involving the right type of customers in opportunity identification / idea generation

Company's objective

Type of customers		Identify new needs	Develop new Solutions
	Lead users / innovators	Inappropriate	Appropriate
	"average" customers	Appropriate	Inappropriate

Figure 5: a "forecasting matrix" for applying the attribute dependency template to
cell phones

	Ringing tone	Ringing style	Speaker volume	…
Ringing tone				…
Ringing style				…
Speaker volume				…
Ambient noise				…
User's calendar				…
…	…	…	…	…

Figure 6: a framework for non-traditional marketing