Chapter 8

New Product Development*

by

John R. Hauser, MIT

and

Ely Dahan

January 10, 2007

Chapter in

Marketing Management: Essential Marketing Knowledge and Practice

Rajiv Grover and Naresh K. Malhotra, Editor

McGraw Hill, Inc., Columbus Ohio

Draft corrections by John Hauser, July 22, 2008

John R. Hauser is the Kirin Professor of Marketing and Head, Management Science Area, MIT Sloan School of Management, Massachusetts Institute of Technology, E40-179, 1 Amherst Street, Cambridge, MA 02142, (617) 253-2929, fax (617) 253-7597, jhauser@mit.edu.

Ely Dahan is an Assistant Professor of Marketing at the Anderson School, University of California at Los Angeles, 110 Westwood Plaza, B-514, Los Angeles, CA 90095, (310) 206-4170, fax (310) 206-7422, edahan@ucla.edu.

INTRODUCTION

Successful new product development (NPD) is a critical cornerstone of firm success (See Chapter 1). Significant incentives exist for firms to continuously introduce viable new products to the markets they serve. The **financial payoff** from successful new product introductions can help many firms overcome the slowing growth and profitability of existing products and services that are approaching the maturity stages of their life cycles. A 1990 study sponsored by the Marketing Science Institute found that 25% of successful firms' current sales were derived, on average, from new products introduced in the last three years <Rajiv to get reference>. New product development can also be a potential source of significant **economies of scale** for the firm. New products may be able to use many of the same raw material inputs as the firm's existing products, and may be able to be sold by the firm's existing sales force – resulting in substantially lower unit costs (and in turn higher margins) for the firm. Furthermore, new product development can be an important source of **leverage** for the firm to use in its relationships with its **distribution channel** partners. Firms that have multiple successful products in their portfolios can command greater attention and priority treatment, such as preferred shelf space and payment terms, from wholesalers and retailers. This is a particularly important consideration given the fact that large retailers, such as Wal-Mart and Target, have evolved into positions of significant channel power and influence. Furthermore, the **image and reputation** of the firm and its brands is heavily influenced by the number and caliber of successful products in its portfolio. Nike has enhanced its overall brand reputation, well beyond the realm of athletic footwear, as a result of its successful introduction of golf equipment and supplies, swimwear, soccer equipment and apparel, as well as numerous successful products that appeal to tennis, basketball, and baseball enthusiasts.

From a broader marketing perspective, firms that develop the necessary organizational structures and processes to continuously and efficiently generate new products are more likely to be in tune with their customers' needs and wants. Direct communication with customers, an essential foundation of new product development, allows firms to learn their needs and tailor products and services to their unique requirements. This direct customer communication permits firms to gain a wealth of useful customer insights that should influence every area of the marketing mix – including pricing, distribution channel, and promotion mix decisions.

Unfortunately, new product development is an extremely challenging and complex process. Innovation is inherently risky, and firms may invest considerable time and money in new product ideas with no guarantee that they will ever become commercially viable. Many new products fail, and the new product development landscape is littered with expensive examples. Although Henry Ford led the way in developing the automobile market, the Ford Motor Company in the 1950s introduced the Edsel and lost more than $100 million. DuPont's Corfam substitute for leather resulted in hundreds of millions of dollars in losses. General Mills lost millions of dollars on the introduction of a line of snacks called Bugles, Daisies, and Butterflies. Gillette lost millions on a facial cleansing cream called Happy Face. Xerox invented the personal computer in 1973 (three years before Jobs and Wozniak got started), but failed to commercialize the "Alto" in spite of it being a brilliant technical success. Exxon lost hundreds of millions on its ill fated forays into office information systems and high-tech electric motors.

New product failure rates are substantial; the cost of failure can be enormous. Various studies routinely report that 30 – 35% of products introduced to the market end up failing, even when the product is simply a line extension of an existing brand, or a new brand introduced in a category where the firm already has a successful product. The failure rate for new products

introduced by firms into altogether new product categories approaches 50%. Without a good new product development (NPD) process, firms can lose the significant investments in research and development, engineering, marketing research, and testing that are made on products/ideas that never return revenue.

In this chapter we discuss a dispersed and integrated new product development process that has proven to enhance success and mitigate failure in product development. We describe each stage of this process and provide examples of how to implement each stage. Throughout this process we focus on the customer and how to respond to customer needs.

NEW PRODUCT DEVELOPMENT: A DISPERSED AND INTEGRATED PROCESS

Without a good NPD process firms cannot efficiently manage the inherent risk of new product development. However, even a good NPD process is inherently complex to manage. A significant measure of complexity results from the fact that communications and information management technologies now allow, and even encourage, the process to be rightfully ***dispersed*** – both organizationally as well as geographically. The benefits of managing NPD as a dispersed process are many. Organizationally, the NPD process operates best when it is able to capitalize on key inputs from multiple functional areas within the firm, including marketing, engineering, production, finance, etc. In general, no single organizational unit optimally represents at the same time the voice of the customer, as well as all of the technical, operational, and financial competences of the firm. The interactions between multiple organizational units are instrumental in influencing the efficacy of the NPD process and, in turn, the likelihood of introducing commercially viable products. The process clearly benefits from inputs gathered from sources outside of the organization – from key customers, from important competitors, and from strategic partners such as the firm's principal suppliers. It is generally accepted that limiting the new

product development process to the insights of only a few people in one certain functional area inside the firm will generally restrict its long term effectiveness, and have a negative influence on the firm's product portfolio.

The NPD process is also becoming increasingly geographically dispersed. Even within a given organization, it is entirely possible that employees representing the important functional areas of the firm may be situated in different locations around the country and across the world. Key marketing personnel may be located in California, the finance department may be headquartered in New York, while the relevant engineering and production personnel for a new product project may be found in several locations across western Europe. As we move into the 21st century, new challenges and opportunities are arising, driven by global markets, global competition, and the global dispersion of engineering talent. The current and future vision of product development is that of a highly dispersed process that capitalizes on the skills and insights of people and organizations spread throughout the entire world.

However, the benefits of dispersion come at a cost. The greater the organizational and geographic dispersion, the more complex and difficult it may be to manage the process. As a result, it is critical that new product development must be managed as an *integrated* process that acknowledges tradeoffs between key measures of new product development success such as customer satisfaction, time-to-market, and cost efficiency, as depicted in Figure 1.
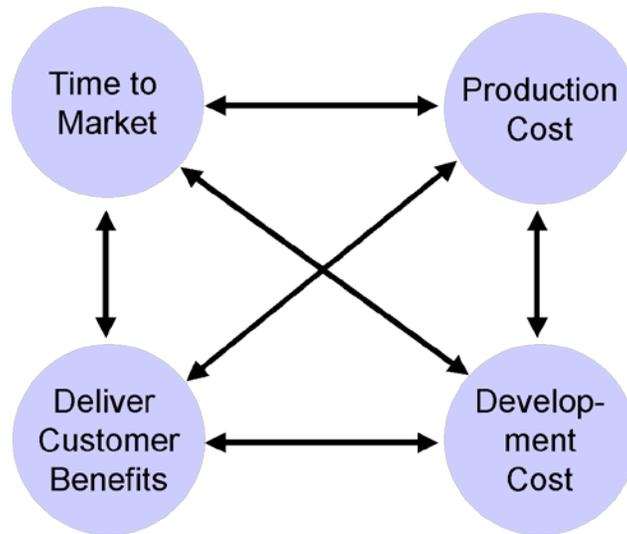
Figure 1: Tradeoffs in New Product Development (from Dahan and Hauser 2003)

Drew: The full citation for Dahan and Hauser 2003 is: Dahan, Ely and John R. Hauser (2003), "Product Management: New Product Development and Launching," Handbook of Marketing, Barton Weitz and Robin Wensley, Eds, Sage Press, (June), 179-222.

All else equal, a product will be more profitable if it delivers customer benefits better, is faster to market, costs less to produce, and costs less to develop. However, while delivering customer benefits is the principal goal, it can't be accomplished at the expense of prudent cost management. While time to market may be a critical concern in intensely competitive markets, it can't be achieved at the expense of delivering the features and benefits that the firm's target market values. How the organization manages these tradeoffs, and coordinates and integrates the many different inputs to its dispersed new product development process, is both difficult and crucial to its success. Marketing, as the primary (yet, not exclusive) advocate of the customer throughout the organization, must acknowledge its responsibility to oversee the new product development process in a way that capitalizes on the benefits of organizational and geographic dispersion, while at the same time managing the process in an integrated, accountable, cost-effective manner.

PRODUCT DEVELOPMENT AS AN END-TO-END PROCESS

A key factor in successfully managing the complexities of new product development in any organization is having a clear understanding of the process. The process is, of course, embedded in an environment. For the NPD process, four elements of the environment can be delineated to be more important – and these are customers, technology, competitors and suppliers. To be successful NPD team actions should be sensitive to the needs of customers, and to competitors, technology, and suppliers. New product development cannot be managed successfully without a clear understanding of *customers* and their changing needs. Much of the focus of this book is on ways and means to satisfy customer needs. Incorporating the "voice of the customer" into the process is critical at every stage – from opportunity identification and idea generation through the actual testing and launching of the product or service. The customer is influenced by the economic, social, legal, and political environment. Firms must become adept at not only *identifying* customer needs, but also at *anticipating* needs that customers themselves find difficult articulate. NPD teams often undertake both ethnographic studies and experiential interviews to identify unmet and difficult-to-articulate customer needs.

For example, in the mid-1960s Ford identified the trend of teenagers and young adults to customize inexpensive vintage Fords with V8 engines. To meet this opportunity they launched the 1964½ Mustang, which captured the hearts of a new generation of baby boomers just reaching driving age (Figure 2a). This small, inexpensive sports car with a powerful V8 engine sold 420,000 units in the first year ($10 billion at today's prices) and went on to launch the lucrative "pony" segment (classicponycars.com/history.html). In 1983 Chrysler introduced the Dodge Caravan and Plymouth Voyager minivans – downsized vans for now-growing families, built on a car-like K platform with comfort features such as power windows, locks, seats, and

quality sound systems (Figure 2b). This new vehicle could carry a 4'x 8' sheet of plywood but,

unlike existing vans, could fit easily in customers' garages, drove like a passenger car, had a side

door for small children, and had a sedan-like liftgate for shopping. Minivans fulfilled these

needs by exploiting front-wheel drive to avoid high floors and to avoid an engine that tunneled

into the cabin. Chrysler sold 210,000 units in the first year and dominated this new segment for

years to come and is still the leader in this segment (allpar.com/model/m/ history.html).

Figure 2
Examples of Significant New Automotive Platform Opportunities
<Note: Need permission for Figure 2b. Figure 2a is my car, so we have permission.>

Drew, I pulled the Dodge Caravan from the web. We don't need this particular picture. Any
reasonable picture of a 1983 Dodge Caravan will do. I don't know if you get permission from
Chrysler or from some image library. We can pay a small fee if necessary.

(a) 1964½ Ford Mustang   (b) 1983 Dodge Caravan

Apart from understanding the customer, NPD teams need to stay abreast of advances being

made in *technology* and by *competitors*.   While quite significant amount of research on science

and technology is done in universities, private research labs in companies conduct considerable

propriety research. Keeping a tab on research being conducted by competitors is one of the

mainstays of competitive intelligence. And, finally, s*uppliers* represent a strategic resource that

should be carefully integrated into the new product development process. Suppliers are valuable

sources of input at all stages from idea generation to designing and engineering. Moreover,

working closely with suppliers can result in the elimination of unnecessary costs throughout the

NPD process and the final product.

Figure 3. New Product Development Funnel

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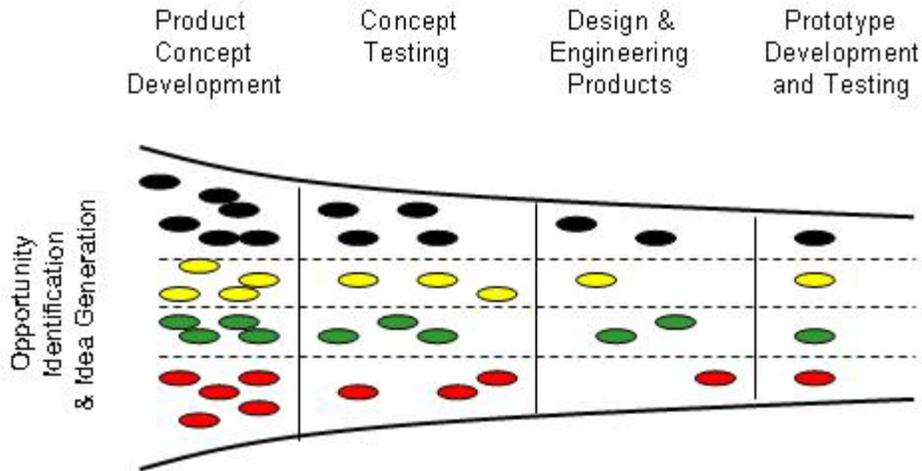
The New Product Development Funnel

Most marketers now view new product development as an integrated, end-to-end process

that involves multiple (iterative) stages as shown in Figure 3. This process is represented by a

funnel (Figure 3) to represent the notion that many different ideas are winnowed and developed

into a few high-potential products that are ultimately launched. The key management issues are (1)

that it is much less expensive to screen and eliminate products in the early stages than in the later

stages, and (2) that each stage can improve the product and its positioning so that the likelihood of

eventual success increases. Such a staged process, summarized by a stage-gate process is likely to reduce overall new product development costs significantly.[1] A stage-gate process facilitates managerial judgment and discipline through the use of a series of "gates" in which members of the NPD team are asked to justify the decision to move to the next stage – where later stages dramatically increase the funds and effort necessary for getting a product to market successfully.

The funnel in Figure 3 also attempts to illustrate the concept of pipeline management by having multiple, parallel sets of NPD projects moving through the funnel at once. Often the best strategy for a firm is to have a sufficient number of parallel projects so that it can launch products to the market at the most profitable pace. The small ovals depicted in Figure 3 are either individual products or **product platforms**. A product platform can be defined as a set of common elements shared across products in the platform family. In many industries, including complex electro-mechanical products, software, and pharmaceuticals, firms have found that it is more profitable to develop product platforms. For example, Hewlett Packard's entire line of ink-jet printers is based on a relatively few printer-cartridge platforms. By sharing common elements, products can be developed more quickly, and at lower cost. Platforms may also lower production and inventory carrying costs, and allow for more flexible manufacturing. From the standpoint of meeting and exceeding customer needs and expectations, product platforms may better enable certain firms to customize individual features for individual customers – a process known as mass customization.

The NPD funnel, depicted in Figure 3, requires careful management of each stage or step, and a go/no go decision at the end of each stage. While the specific implementation of each step may vary depending upon the new product, the firm and the environment, any firm is likely to be more successful in developing new products if it understands and manages each of these steps effectively.

We next discuss each of these five stages that occur before the full-scale commercial launch of the new product: 1) Opportunity Identification and Idea Generation, 2) Concept Development, 3) Concept Testing, 4) Design and Engineering, and 5) Prototype Development and Testing.

STAGE 1: OPPORTUNITY IDENTIFICATION AND IDEA GENERATION

Perhaps the highest leverage point in the NPD process is the first step located at the opening of the funnel on the left hand side of Figure 3. This is where new product *opportunities* are identified or new product *ideas* are generated based on *unmet customer needs*. While customers are the most obvious sources of unmet needs, firms cannot afford to ignore its key suppliers and its own employees as valuable sources of opportunities and ideas. Marketing's role at this stage of the process is to reduce uncertainty during the NPD team's search for winning product concepts by accurately capturing customers', suppliers', and employees' points of view about customers' needs and communicating them to the team. However, there are many nuances and challenges when attempting to capture the voice of the customer, assess customer needs, measure preferences, and predict new product purchase behavior. These are (1) customers may still be forming their preferences and may change their opinions by the time the actual product ships, (2) it may be difficult for customers to articulate and express their true preferences (e.g., for really new products or product features), (3) the questioning process itself can be intrusive, often requiring the use of multiple, convergent data collection methods, and (4) the information gatherers themselves may "filter" the voice of the customer through their own individual biases. Keeping these challenges in mind, we discuss two classes of data gathering techniques, Experiential Interviews and Empathetic Design/User Observation that capture potentially profitable unfilled customer needs.

Experiential Interviews

Historically, many organizations have relied on focus groups to provide valuable new product development insights. In many situations focus groups provide valuable data on customers, particularly when social interaction between focus group participants is important. The focus group may end up communicating the viewpoints of only one or two outspoken participants, as opposed to all of the participating subjects. As a result, many firms are turning to experiential interviews in which the needs and desires of customers are explored in one-on-one interviews where the individual customer describes in detail his or her experiences with the product class. The interviewer probes deeply into the underlying, more stable, long-term problems that the customer is trying to solve.

In selecting interview candidates, a key objective is to acquire a sample of different types of customers so that the NPD team receives information from all of the relevant segments, and from customers with varying perspectives. Because non-verbal communication can be critical, many firms now retain video of the experiential interviews in addition to simply transcribing them. Such interviews, often distributed to NPD team members, have become known as the "Face of the Customer (FOC)." Furthermore, many firms now include the product-design engineers in the interviewing process when it is cost-effective to do so.

Underlying Meanings and Values In addition to *exploring* customers' stated needs, NPD teams often seek to *understand* customers' underlying meanings and values. Focusing on *why* customers have a particular need often reveals many additional ideas for product design. For example, customers' desire for a small notebook might stem from two very distinct reasons. One customer might need to travel extensively for her work and, hence, need to work with and lay the notebook in many different odd places including, for example, on the tray tables of airplanes.

Another customer may desire a small notebook because it just looks more elegant. It is part of the customer's persona and a small notebook fits well with the quality of other accessories such as a cell phone or travel bag. The implications of the two reasons behind the need for a small notebook can be many. It is quite likely that the first customer would also then require a longer battery life to keep the computer operational over long flights, a more ergonomic keypad, and a more robust and shock-proof body. For the second customer these attributes might not be as important, and the customer might prefer a lighter-weight and slimmer notebook. Depending on the underlying meaning and value, the two product concepts could be quite different. This technique of asking why customers prefer an attribute at higher and higher levels of abstraction until some core values are reached is called laddering.   Figure 4 illustrates the laddering technique for the above notebook example.
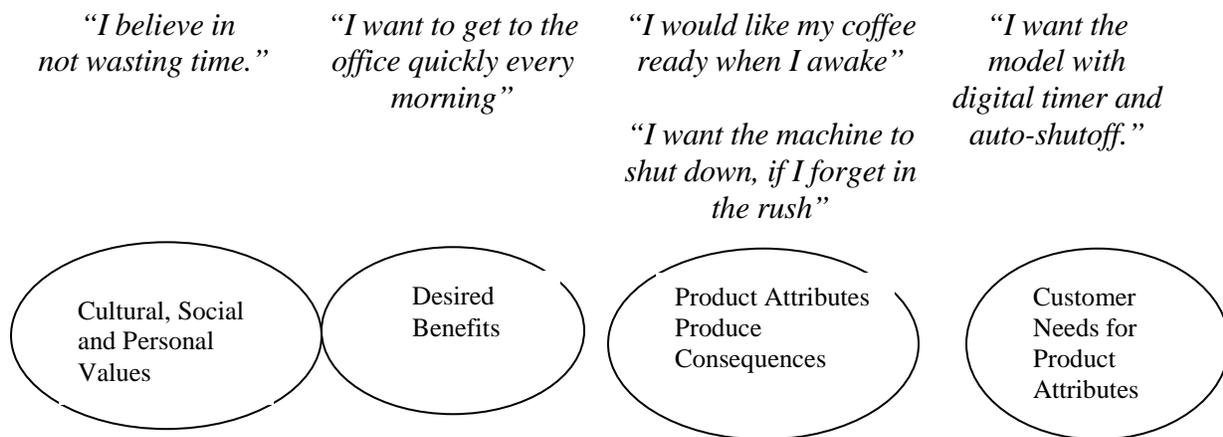
Figure 4. The Laddering Technique (adapted from Dahan and Hauser 2003)

Notebook computer needs to be small → easier to take places → use more often → accomplish more → feel better about myself

Notebook computer needs to be small → easier to take to people → looks good → impress people → feel better about myself

Implied in the Laddering Technique is that human beings assimilate benefits as a hierarchical stack. Such a conceptualization of needs that link product attributes to higher and higher levels of abstract benefits has been called "benefits chain", "means-end chain", or "value-systems models."[2]   This conceptualization implies that the underlying cultural, social, and personal values held by individuals guide their choices of products and services. Figure 5 presents an example of a benefit chain for a coffee maker.

Figure 5. Linking Values to Product Attributes (from <mark>Dahan and Hauser 2003</mark>)

"I believe in not wasting time."   *"I want to get to the office quickly every morning"*   *"I would like my coffee ready when I awake"*   *"I want the model with digital timer and auto-shutoff."*

"I want the machine to shut down, if I forget in the rush"

Cultural, Social and Personal Values   Desired Benefits   Product Attributes Produce Consequences   Customer Needs for Product Attributes

Empathic Design and User Observation

Many firms realize that no matter how refined the research methodology and no matter how much data is collected, some insights can only be gained by observing customers in their natural habitats. This is particularly true when customer needs are difficult to verbalize or are not obvious. The technique of empathic design requires that members of the design team immerse themselves in the customer environment for a period long enough to absorb the problems and feelings experienced by users. Cultural anthropological and ethnographic techniques are also examples of such data collection techniques. If a product is inconvenient, inefficient, or inadequate, the designer can gain first-hand experience with the problem. Empathic methods are particularly effective at determining the ergonomic aspects of a product. A select group of products, especially "high-touch" consumer durables such as automobiles and personal information appliances, are purchased as much for the emotional responses they evoke as for the functionality they provide. For such products, measuring customers' true feelings and attitudes toward potential designs, especially their look and feel, may prove invaluable.

Non-verbal responses can be observed using indicators such as galvanic skin response, voice stress, breathing rate, facial muscle contractions, eye movement and dilation. By measuring these subtle physiological responses while a customer views or interacts with a new product, the NPD team gauges the customer's feelings and attitudes. A grimace during sharp steering might indicate poor response in a car, while visual focus on a particular coffee maker prototype might reveal a preference for the outward appearance of that design. By correlating the non-verbal reactions of customers with the specific stimuli that produced them, customer preferences for a product's look and feel can be determined. The empathic methods can be carried out by members of the NPD team (after receiving the appropriate training) or by marketing professionals, but in either case, rich media should be used to capture the users experience so that it can be shared with the entire team.

Intuit, makers of Quicken®, the popular personal financial software package, pioneered the "Follow-Me-Home" program in which Intuit employees observe purchasers in their homes from the moment they open the box to the time they have Quicken functioning properly. Using empathic design and user observation, Intuit has steadily improved Quicken's ease-of-use with features such as auto fill-in of accounts and payees, on-screen checks and registers that look like their paper counterparts, and push buttons to automate common tasks. More importantly, Intuit took responsibility for the entire process of producing checks – including working to improve printers and printer drivers even though these were made by third parties. Empathic design highlighted problems that explained why some customers were not buying Intuit's products. Even though the problem was not Intuit's technical responsibility in the supply chain, Intuit took responsibility and solved the customers' perceived problems. Specifically, Intuit recognized that it could lose market share if it did not solve the printer manufacturers' software <u>and</u> hardware

problems. Intuit's empathic focus on customer needs has kept the company on top of a highly competitive, ever-changing marketplace.

Focusing the Design Team by Identifying Strategic Customer Needs

Data gathering techniques can produce hundreds of ideas and unfulfilled customer needs. Even for a simple product such as a coffee maker, it is not uncommon to generate a list of 100-200 different customer needs. For complex products such as copiers and automobiles, such lengthy lists might be generated for each of a product's individual subsystems (e.g., interior, exterior, drive train, electronics, climate control). To proceed further in idea generation, the NPD team needs focus. This focus is provided by recognizing that all needs are not independent, and many needs can be grouped into strategic, tactical, and detailed needs. Such grouping is done using voice-of-the-customer methods.[3] For example, each tactical need may be written on a card. The cards are then shuffled and customers sort them based on similarity. Clustering methods are then used to identify a hierarchy of customer needs.

If we call the raw output of the various needs-generation methods "detailed needs," then we often find that the 100-200 detailed needs can be arranged into groups of 20-30 tactical needs. For example, detailed statements by software customers about the on-line help systems, "wizards," on-line manuals, documentation, telephone support, and Internet support might all be grouped together as a need of the customer "to get help easily and effectively when I need it." The detailed needs help the NPD team create technology and other solutions to address the tactical need. However, the tactical need is sufficiently general so that the NPD team might develop totally new ways of meeting that need. The tactical needs might also be grouped into 5-10 strategic needs such as "easy to use," "does the job well," "easy to learn," etc. The strategic

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needs help the team develop concepts that stretch the product space and open up new positioning strategies.

Later in the NPD process the team needs to decide upon which strategic need to focus, or which specific features best fulfill a strategic need. However, in the opportunity identification / idea generation stage it is more important to generate a larger number of potential product ideas so that the possibility of identifying the right strategic and tactical groups of needs is high.

Web-based Methods for the Fuzzy Front End

The Internet has made it possible for groups of customers to communicate directly and iteratively with one another and, together, identify a set of needs that might not have been identified any other way. The "virtual focus group" participants opine on a common stimulus such as a new product concept. Increasingly firms are finding such virtual focus groups and individual browsing behavior of investigating a new product stimuli on the net to be very highly rewarding. For idea generation, a statistical random sample is not required as long as the respondents are representative of the targeted segment.

STAGE 2: PRODUCT CONCEPT DEVELOPMENT

Once the NPD team has identified and grouped customer needs, it must generate product concepts on how to address those needs. In a subsequent stage of the new product development process (designing and engineering concepts), we examine formal methods for systematically generating effective new product concepts, such as Quality Functional Deployment (QFD). A few good ideas often come from a much larger set of total ideas, some good and many not. Many good ideas start out as unconventional, impractical (in some cases bizarre) ideas that are shaped and refined into viable opportunities by the NPD team. Therefore, at the Concept Development stage, the premium, at least initially, is variety. The more different "spaces" are

explored, the higher the probability that the best ideas will be good ideas that can position the organization to satisfy customer needs in new and creative ways. A wide variety of ideation methods have been proposed, including brainstorming, and incentive-compatible ideation, morphological analysis, forced relationships, systems approaches, varied perspectives, and archival analysis.[4]

Brainstorming

Brainstorming is a method of shared problem solving in which all members of a group spontaneously contribute ideas, including seemingly unrealistic ideas – which often serve as a catalyst that stimulates the generation of additional, more-realistic ideas. Brainstorming participants are instructed to accept any and all ideas as useful inputs to the process. A key rule is that criticism of any generated idea – regardless of how unrealistic it may be – is expressly forbidden. Brainstorming hypothesizes that criticism of an expressed idea may cause participants to refrain from contributing additional ideas due to the fear of judgment or ridicule – undermining the purpose and outcome of the process.

An alternative approach – called *brainwriting* – can overcome some of the limitations of conventional brainstorming. With brainwriting, participants arrange themselves in a circle and write down their ideas instead of calling them out in front of the group. Typically, a set of index cards is provided to all participants. When a participant has written down two or three ideas on a card, the card is then passed to the adjacent person. That person reads the ideas and either tries to elaborate on them, or tries to use them to generate additional ideas. Cards are repeatedly and continuously passed around the group – making it nearly impossible to determine the original source of the idea. There are no explicit ground rules – even the most ridiculous idea is encouraged because it may serve to stimulate a more realistic idea. The more anonymous nature

of brainwriting often result in the stimulation of many, many ideas by the NPD team. While most of these ideas may be impractical and infeasible, in most cases at least a few of the generated ideas will turn out to be ones that the NPD team can shape and develop into an idea worth pursuing further.

The Idea Game

As the Internet becomes more prevalent and accepted for management processes, idea generation has moved to web-based methods. A prime example is Toubia's idea game.[5] The idea game overcomes many of the criticisms of brainstorming. First, by using the web in an asynchronous game, participants can post ideas, expand ideas, and comment on ideas at their convenience from anywhere in the world; they do not all have to be in the same room at the same time. Participants use pseudonyms so that organizational politics do not interfere. Second, ideas are organized in threads so that participants can easily build upon other ideas. Third, the incentives are balanced so that respondents think hard and post only those ideas that are new, different, and incremental. Toubia achieves incentive compatibility by providing a balanced set of incentives: participants earn rewards for posting new ideas, but the largest rewards come when other participants build on your idea. To avoid redundancy, any participant can challenge another's idea if it perceived as redundant. Challenges are adjudicated by a monitor. Note that neither the challenges nor the monitor is asked to judge the quality of the idea – only its redundancy.

Morphological Analysis

Morphological Analysis is a method for identifying and investigating the total set of interesting new combinations of product attributes and features. In this technique, the NPD team first lists the key attributes of the given product or service. For the coffee-maker example, the

attributes might include capacity, color, style, shut down methods, turn on methods, filter shape, material, and clock attributes. After listing all possible attributes, the NPD team creates a table using each of these attributes as column headings (see Figure 6 below), and generates as many existing and potential variations of each individual attribute as possible. The resulting table should shows all possible variations of each attribute. Morphological Analysis entails randomly selecting one item from each column and investigating the novelty, plausibility and applicability of each combination.

Figure 6. Attribute Listing for Morphological Analysis

Drew: No need for permission.

Capacity	Color	Style	Shut Down	Turn On	Filter Shape	Material	Clock	Other Features
One Cup	Black	Traditional	Auto	Auto	Traditional	Plastic	Digital	Grinder
Two Cup	Grey	Modern	Manual	Manual	Conical	Stainless Steel	Analog	Espresso Maker
Four Cup	White	Compact				Ceramic		Milk Steamer
Eight Cup	Red					Glass		Water Filter
Twelve Cup	Blue							Freezer for Coffee Bean
	Steel							

Forced Relationships

A classic idea method relies upon the creation of a *forced relationship* between two or more normally unrelated products or ideas. A good example of the use of forced relationships is the ongoing series of innovations coming from cell phone manufacturers. Some of the forced relationships that have stimulated successful product developments include cell phone/camera, cell phone/MP3 player, and cell phone/internet access device. Another possibility would be using cell phones as credit cards – replacing the need to carry and use plastic credit cards when purchasing goods and services. Using our coffee maker example, a NPD team might consider a

forced relationship between a coffee maker and a food processor. Can some aspects of these two products be combined into one? Can the coffee-maker be enhanced by taking features from a food processor? Clearly, the coffee bean grinder comes to mind.

Systems Approaches

A *systems approach* to generating new product ideas focuses NPD members' attention on how the product or service fits into the overall life (or system) of the user. This approach is based on the premise that there exists in life a universal "system" of organization that underlies the whole of our experiences. In terms of any creative process (e.g., new product development), understanding the overall system can help one to see any given part (our product or service) in relation to the whole. Using the coffee maker example, one could look at how a coffee maker fits into the life of the user. If the user is pressed for time in the morning, he or she could benefit from an automatic brewing feature. If he or she lives alone, a one-to-four cup capacity machine will most likely suffice. If he or she is a coffee connoisseur, a built-in coffee grinder could be an important feature. The NPD team's ability to listen to customers' needs and generate product/service ideas designed to satisfy them can be greatly enhanced by understanding how the firm's offerings fit into the lives (systems) of its customers.

Varied Perspectives

Members of a product design team often have diverse creative perspectives. DeBono's six hats model represents the variety of different member perspectives. The white hat is concerned with information, the red hat has to do with feelings, the black hat is for caution, the green hat is the creative energy hat (which stimulates the generation of possibilities), the blue hat is for looking at the thinking process itself, and the yellow hat looks at the benefits of a suggestion. Typically, NPD team participants feel most comfortable wearing only one or two of

the six different hats. Using DeBono's six hats model in a new product development context

requires team members to analyze a new product idea from the perspective of *each one* of the six

hats so as to improve communications and foster creative exchange.

Applying this approach to our coffee maker example, a group member might suggest a

coffee maker with a built in water purification filter that would make the coffee taste better. The

person wearing the white hat might ask exactly how the filter will work? Where will it be

located on the machine? How often will it need replaced? The red hat would tell the group how

the water filter makes him feel, without explaining why it makes him feel this way. The black

hat would point out why the filter would not work. The individual wearing the green hat would

suggest other possibilities for the water filter, such as using a filter that not only makes the coffee

taste better, but also removes harmful bacteria from the water. The blue hat would set a goal for

the session, deciding exactly what is to be accomplished by the end of the allotted time. In this

case the goal could be to determine if the idea is strong enough to spend the money to develop a

prototype. The yellow hat would summarize all of the benefits of the idea. DeBono's model can

be effective in not only stimulating useful ideas, but also in creating valuable discipline and skill

among team members by forcing them to think and work outside their normal comfort zones, and

to consider different perspectives (wear different hats) than they normally would.

Archival Analysis

Archival analysis (also known as TRIZ) involves critically and judiciously gathering and

analyzing the ideas of others who have solved problems in other domains in order to help solve

the problem on hand.[4] It attempts to document and summarize all solutions to problems that are

relevant to the firm or the NPD team. It then creates a universal table or template that lists

possible solutions to potential problems facing the NPD team. Using the coffee maker example,

if the design team desires the machine to be strong, lightweight, and stain resistant, they could look at a list of possibilities generated by archival analysis and determine that titanium should be considered for use as the basic material.

It is worthwhile pointing out here that not all product features are "equally" valued by customers. The Kano model characterizes product features according to their relationship to customer expectations.[5] Some product attributes/features address "must have" needs. Such needs are usually met by current products and any new product must satisfy these needs. If the new product does not meet these needs (e.g., an automobile must have four properly inflated tires that perform robustly under all commonly occurring types of driving condition), then the product will fail. However, there are opportunities to save costs if new technologies can be used to address these must-have needs as well or better at a lower cost.

Other needs are classified as "more the better." When new technology or improved ideas increase the amount by which these needs are satisfied, customer satisfaction increases, but usually with diminishing returns. Such needs are usually relevant when technology is advancing rapidly, such as with computer processor power. In order to stay on top of the market, a computer manufacturer must always be developing more powerful and easier to use computers.

Finally, a special class of needs are those which customers have difficulty articulating or rarely expect to have fulfilled. When features are included in a product to satisfy such customer needs, often unexpectedly, customers experience "delight!" Sources of customer delight can become strong motivators for initial purchase and for customer satisfaction after the sale. Examples include complementary fruit baskets in hotel rooms, software that anticipates your next move, automobiles that rarely need serviced. Conceptually, once a product provides one or more

"delighter" features that surpass a certain threshold of functionality, customers become extremely satisfied and seek out the product for those features.

Inventive Templates

Goldenberg, Mazursky, and Solomon propose that ideation is more effective when the NPD team focuses on five templates – well-defined schemes that are derived from an historical analysis of new products. The authors define a template as a systematic change between an existing solution and a new solution and provide a method by which the PD team can make these changes in a series of smaller steps called "operators:" exclusion, inclusion, unlinking, linking, splitting, and joining. For example, the "attribute dependency" template operates on existing solutions by first applying the inclusion and then the linking operators. The authors give an example of how a new car concept was developed by creating a dependency between color and the location of a car's parts. Specifically, Volkswagen's "Polo Harlequin" features differently colored parts and has become quite popular in Europe even though it was initially intended as an April Fools' joke, Other templates include component control (inclusion and linking), replacement (splitting, excluding, including, and joining), displacement (splitting, excluding, and unlinking), and division (splitting and linking).

To summarize, the NPD team uses one or more of the above techniques to generate product concepts given the unfulfilled needs uncovered in the first stage. The NPD team is now ready to test these concepts to select a few that will be further developed.

STAGE 3: CONCEPT TESTING

More new product opportunities and ideas are generated by the firm than are actually introduced as commercially viable offerings. However, the track record of some firms in converting ideas into actual products is arguably better than others. Some firms have a measure

of rigor and discipline in their NPD processes that other firms do not. One area where such rigor

and discipline is critical is concept testing. Concept testing is a pivotal step that plays a vital role

in the new product development process. Here, new product concepts are screened with

potential customers using both quantitative and qualitative research methods. Evaluations on

such measures as consumer relevance (how important is the consumer need being addressed by

the innovation), consumer purchase interest, and dissatisfaction with currently available products

are used to prioritize ideas for further testing, evaluation, and funding.

Concept Definition

Concept definition is a statement or promise to the customer that (1) demonstrates that

the firm has gained the necessary insight to accurately understand customers' relevant needs, (2)

credibly explains/proves how the firm is positioned to address such needs better than anyone

else, (3) provides a rational or emotional reason for the customer to want to try the product or

service, and (4) defines and communicates the concept's core benefit proposition (CBP) – the

key benefits of the proposed product or service based on both customer needs and competition.

The concept definition often takes the form of "stretcher" concepts, each of which

explore a different strategic need by emphasizing or "stretching" it. For example, if a firm is

developing a laundry detergent and knows that the strategic needs are cleaning, gentleness, safe

for the environment, easy to use, among others, the firm might generate a concept that

emphasizes each strategic need and promises more than can be delivered.

For example, consider a leading business school that is seeking to develop a new program

on entrepreneurship. The program manager may develop four one-page description of a web

advertisement that describes the program. Each advertisement will talk about curriculum, the

type of students, the likely job placements, and other features. However, the four descriptions

might vary on key dimensions. One concept might stress technological entrepreneurship with a strong engineering focus and placements in high-tech start-ups. Another concept might stress service innovations, curricula that stress the management of customer-contact employees, and the "gap" model of customer satisfaction. A third concept would focus on entrepreneurship within organizations and a fourth on entrepreneurship in developing countries. The basic idea is that each concept is extreme in that it stretches a potential dimension of need. After potential students and recruiters react to the stretcher concepts, the school might generate new, less extreme concepts that combine the best and most popular features of the stretcher concepts. Throught such an iterative process, the firm zeros in on the best concept positioning.

Today's concepts take many forms. They can be as simple as one-page statements or as complex as product prototypes. More and more, the concepts are virtual – advanced computer software enables researchers to simulate highly visible and interactive concepts that simulate product use and there is good evidence that consumers react to such virtual concepts the same way they react to real prototypes.[6]

Concept Evaluation

Concept evaluation is a well-developed science based on both survey research and laboratory test markets (LTMs). Predictions are highly accurate and provide important information to new product teams so that they might evaluate concepts and improve the concepts.[7] In a typical survey-based approach, a representative sample of respondents are presented with 3-4 concepts and asked to evaluate them. Respondents evaluate the concepts on their ability to fulfill customer needs and on overall preference and they often indicate their intentions to purchase a product based on the concept. The typical laboratory approach approximates the purchase environment. The setting is more realistic, many elements of the

marketing mix are used, and the concepts are closer to the product or service that will appear in the marketplace, For example, respondents might be presented with advertising for the concepts, often simply storyboards rather than finished advertising, and presented with prototype products. In some cases, respondents indicate their intentions to purchase, but, if the concept is well along, they might get a chance to purchase the product in a simulated store. The key outputs are (1) a sales forecast that is sufficiently accurate for a go vs. no-go decision and (2) diagnostic information that helps the new product team refine the concept so that it better meets customers' needs and expectations.

Forecasting

Because more valuable resources are expended as the concept moves through the new product development process, it is critical that firms estimate the revenue and profit potential of the concept as early as possible in the process. One way to focus concept development on high-potential concepts is to classify concepts as (1) clearly worth further development, (2) clearly worth dropping, and (3) questionnables – need more data. One output of concept evaluation is a rough sales forecast. It may not be sufficiently accurate for a final launch decision, but it is often sufficiently accurate to make early decisions to focus on a few high-potential concepts.

As in all forecasting, there is a tradeoff between accuracy and cost. For example, the more realistic the concept (prototype vs. paper-and-pencil) the more accurate the forecast.   As the product concept moves through the new product development process, concepts are refined and more accurate forecasts become available.

STAGE 4: DESIGNING & ENGINEERING PRODUCTS

Once the new product team is focused on a relatively few high-potential concepts, the concepts have to be designed and engineered to meet customer needs at a cost that is profitable to

the firm. Conjoint Analysis and Value Engineering are two techniques that are used to design and then engineer products.

Conjoint Analysis

After customer needs are identified and grouped, and after critical product features are identified and linked to customer needs, the NPD team's next step is to optimize the level or quantity of each feature/attribute that is most likely to satisfy customers and/or lead to profitable products. Conjoint Analysis is one of the most popular methods to assist with such decisions. The goal of conjoint analysis is 1) to help determine the level of each product feature that would be the most acceptable to an identified segment of customers, 2) to infer the relative importance or influence of each individual feature on the total perceived utility of the product, and 3) to estimate the contribution to utility of each feature at each of its various levels. For example, a maker of cameras might want to know the optimal values for each of the following features - Size, Megapixel, Optical Zoom, and Price – for a camera targeted to a particular segment. Or, the manufacturer might want to know how consumers would make trade-offs between features (e.g., an increase in megapixels with a decrease in optical zoom while keeping the price constant).

There are several varieties of conjoint models. These varieties include the traditional full-profile method as well as the newer adaptive, hybrid and discrete-choice conjoint methods. At the heart of most conjoint methods is the multi-attribute additive model of consumer choice. (Recall from Chapter 2 that there are several models of consumer choice such as compensatory multi-attribute, lexicographic, conjunctive and disjunctive.) The compensatory multi-attribute model essentially states that the utility (U_{bp}) for a particular alternative/brand *b* for person *p* is based on the features of the brand, in particular, as a compensatory sum of those features. Thus, in our camera example, consumers receive utility through size and price (the smaller and lower

the better respectively), as well as megapixel and zoom (the more the better). Conjoint analysis

procedures differ in the format of data collection and the estimation methods used and these are

discussed next.

Format of Data Collection for Conjoint Analysis

The traditional conjoint-analysis format is based on full-profile stimuli where each

product profile is described by the levels of the features that it contains.   The respondent can be

asked to rank order all stimuli or to provide a metric (interval scaled, see Chapter 7) rating of

each stimulus. In some hybrid methods, the experimental designs are blocked across

respondents. Full-profile analysis, in which the respondent sees all features of the profile,

remains the most common form of conjoint analysis and has the advantage that the respondent

evaluates each profile holistically and in the context of all other stimuli. Its weakness is that the

respondent's burden grows dramatically with the number of profiles that must be ranked or rated.

Whenever the analyst is comfortable that tradeoffs among a reduced set of features do not

depend upon the levels of the other features, partial-profile conjoint analysis might be used. In

this case, respondents can evaluate partial profiles in which some of the features are explicit and

the other features are assumed constant. Typically, the respondent is asked to evaluate pairs of

partial profiles.   See Figure 7a.

Drew: Figure 7a from Toubia, Olivier, Duncan I. Simester, John R. Hauser, and Ely Dahan

(2003), "Fast Polyhedral Adaptive Conjoint Estimation," Marketing Science, 22, 3, (Summer),

273-303. Figure 7b from Toubia, Olivier, John R. Hauser, and Duncan Simester (2004),

"Polyhedral Methods for Adaptive Choice-based Conjoint Analysis," *Journal of Marketing*

Research, 41, 1, (February), 116-131.

Figure 7. Example Conjoint Analysis Formats

(a) Partial Profile Question
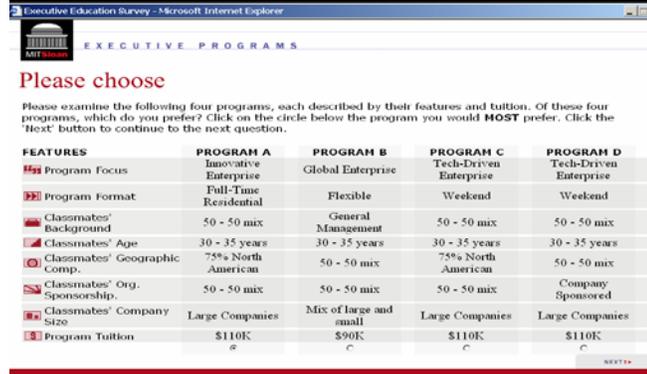
(b) choice-based question

Because partial profiles are well suited to presentation on computer monitors, researchers have developed adaptive methods in which the next set of partial profiles presented to respondents is based on the answers to the preceding sets of partial profiles. The best-know example of such adaptive selection of partial profiles is Johnson's (1987) adaptive conjoint analysis (ACA). In ACA, respondents are first asked a set of self-explicated questions (see below) to establish initial estimates of importances. Then, based on intermediate estimates of the values of the features, new profiles are chosen that are close in utility (utility-balanced). ACA has a long history and, in general, provides accurate estimates when both the self-explicated data and the partial-profile data are used in the estimation. (www.sawtoothsoftware.com).

Recently, new methods for adaptive question selection have been proposed that are more efficient in selecting profiles with the greatest information content. In these "polyhedral" methods each question constraints the feasible set of partworths.[8] These methods select the next profiles to provide information on those features where there is the most uncertainty in value. They have proven accurate and are diffusing rapidly.

A third form of data collection is stated preferences, also know as choice-based conjoint analysis, CBC.[9] This form of data collection is rapidly growing in popularity. See Figure 7b. In

CBC, respondents are presented with sets of full-profiles and asked simply to choose the profile they prefer. Typically, the sets contain four profiles, but more or less are feasible, and, in many cases, respondents are allowed to select the "no profile" option. CBC's growth is based on the belief among many researchers that it best approximates a consumer's actual purchase task. Researchers have developed a variety of adaptive questioning procedures for CBC.[10]

The final form of data collection is self-explicated questions in which respondents are asked to state directly the importance of features and the contribution of each level of a feature. In theory, it should be difficult for respondents to provide such judgments, but empirical experience suggests that such questions can be quite accurate. Conjoint methods such as Casemap and Asemap rely entirely on self-explicated judgments and has proven to predict well.[10]

Self-explicated methods have also proven powerful when used in conjunction with full-profile methods in a form of conjoint analysis known as hybrid conjoint analysis.[11]

Estimation Methods for Conjoint Analysis

The basic conjoint problem is to estimate the partial contribution of each level of each feature, known as a partworth, that best explain the overall preference judgments made by respondents. When respondents evaluate either full- or partial-profiles on a ratings scale, then ordinary least-squares (OLS) regression is a natural and relatively straight-forward means with which to estimate the partworths (see Chapter 7). If the data are ranked, then either monotonic regression, linear programming, or ranked "logit" models provide accurate partworth estimates.[12]

When the data are choice-based (CBC), analysts use random-utility models. The basic idea is that respondents are maximizing utility, but make response errors, hence the choices are the result of both true utilities and random errors. There are many specifications, but the most common is a model known as the logit model.[13] The advantage of random-utility models are

that they are derived from transparent assumptions about utility maximization and that software is readily available to analyze such data. The disadvantage is that the number of choice observations required to obtain practical estimates for each respondent if often prohibitive. This has changed with hierarchical Bayes estimation.

One of the greatest practical challenges in conjoint analysis is to get sufficient data for partworth estimates with relatively few questions. This leads to tension in the experimental design. The researcher would like partworth estimates for each respondent to design a product line, and segment the market if necessary. On the other hand, if the respondent is forced to answer too many questions, the respondent becomes tired, provides noisy data, or quits the questionnaire. Adaptive methods (see above and hierarchical Bayes (HB) estimation address this tension.

The basic idea behind HB is quite simple. There is uncertainty about each respondent's partworths. However, the parameters of that uncertainty vary across the population (hence the hierarchy). Researchers establish prior beliefs and update those beliefs based on the data and Bayes theorem bouncing back and forth between estimates of the population's partworths and the partworths for each respondent. The net effect is an efficient use of the data to provide extremely accurate estimates of the distribution of partworths across the population of respondents. Individual estimates are a combination of population estimates and respondent-level estimations. In essence, this "shrinkage" to the population, makes respondent-level estimates more accurate and less sensitive to noise.

In the last few years, researchers have recognized the power of new optimization methods. These optimization methods run extremely fast on today's computers and provide the means to do extensive computations between questions (for intermediate estimates) or after all

the data are collected (for revised estimates). There are many such approaches. For a review of these methods see Toubia, Evgeniou and Hauser (2007).

Value Engineering: Quality Function Deployment/House of Quality

From a customer's point-of-view, a product consists of a bundle of features and benefits resulting from its use. From the firm's perspective, the product consists of a bundle of parts and the processes that result in its manufacture. When making cost and feasibility tradeoffs, it is important for the design team to integrate both customer and firm perspectives. This is known as value engineering; it relates the importance customers place on each function performed by a product to the cost of the parts contributing to that function. A key principle underlying value engineering is that the marginal cost of each part of a product should be less than its marginal contribution to customer value. To implement value engineering the team must know (1) the value placed by customers on each function and (2) the cost of the parts and manufacturing to provide that function.

Value engineering requires that we link customer needs to product solutions so that the NPD team can make intelligent tradeoffs and, perhaps, find creative solutions that do not require tradeoffs. Quality Function Deployment (QFD) provides one method to make this linkage. QFD itself is a set of processes that link customer needs all the way through to production requirements. Although the full QFD process is sometimes used, it is the first matrix of QFD, called the House of Quality (HOQ), which is used most often. The driving force behind the HOQ (see Figure 8) is the short, accurate, relevant list of key customer needs identified and structured into strategic, tactical, and detailed needs. In the HOQ, these needs are related to product features, which are then evaluated as to how well they meet customer needs. Product features are "benchmarked" against competitors' features in their ability to meet customer needs, and the HOQ is used to compare the

benchmarking on features to benchmarking on customer needs. Finally, the total product is evaluated by the ability of its features to meet customer needs more effectively and at lower costs than competitive products.

Figure 8. The House of Quality (from Dahan and Hauser 2003)
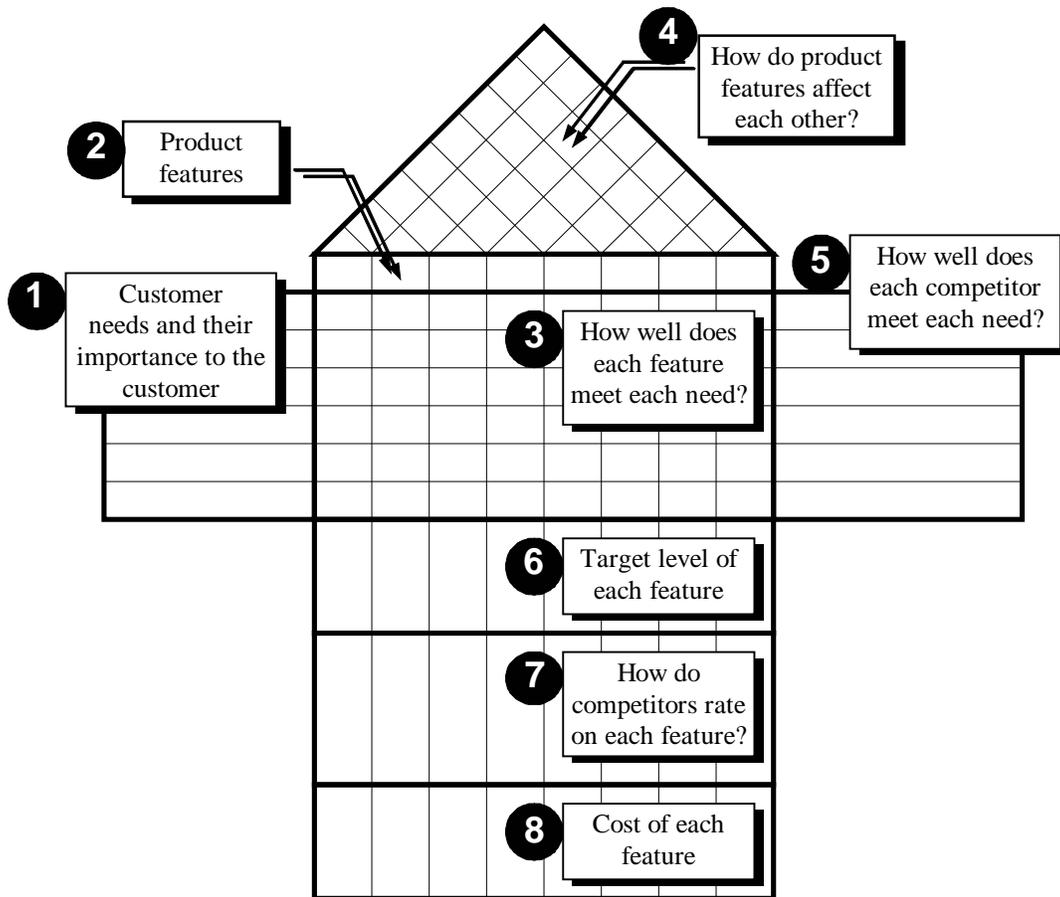
The HOQ provides and organizes the information that the NPD team needs to refine each concept. It has proven effective in a variety of applications including frequently purchased consumer goods, consumer durables, consumer services, business-to-business products, and business-to-business services. A further advantage of the HOQ and related techniques is that it enhances communication among NPD team members. This is becoming even more important as NPD teams become more dispersed and global. The downside of QFD is that strict adherence to

the method can be complex and extremely time-consuming, especially for products with many customer needs and engineering "key characteristics."

Clearly, firms must adapt the House of Quality to produce benefits commensurate with these implementation costs. Current practice is turbo-HOQ or just-in-time-HOQ in which PD teams focus on a subset of customer needs and investigate those actions or engineering key characteristics that just affect those needs. As the product concept progresses, the focus shifts and more of the HOQ is completed. In this way PD teams balance focus with completeness.

Ironically, complex projects that make QFD difficult to implement may be the very ones that benefit most from improved communication and coordination within the firm. Marketing's primary input to the HOQ includes identifying customer needs, measuring how products fulfill those needs, and understanding the tradeoffs among customer needs and among potential product features. Ultimately, the HOQ method translates customer priorities, as captured by a prioritized list of needs, into engineering/design priorities by identifying those product features that contribute the most to satisfying customers better than competitive offerings.

Web-based Methods for Designing and Engineering Product Concepts

The advent of new information and rapid-communication technologies such as extremely powerful desktop computers and the World Wide Web (web) have led to effective and efficient methods for designing products. We review some of these methods here. Web-based conjoint analysis offers clear advantages because product concepts can be demonstrated in a rich and contextual manner. For example, as demonstrated in Figure 9a, respondents can be shown how they can use the camera. Respondents can also view different animations of the camera and visualize how the pictures will be used. Similar screens enable respondents to better understand the features that are being varied. Respondents then can be presented with a conjoint analysis

task (Figure 9b shows a paired comparison task). The task is made easier by animating the scale

and by making detailed feature descriptions or product demonstrations available with a single

click. The additional advantage of web-based conjoint analysis is that respondents can complete

the task remotely in the comfort of their homes. There are many commercial panels available

(and some proprietary) that make it quick and easy to access web-based respondents. Such

panels can be balanced on a variety of demographic characteristics to provide representative

samples of potential consumers.

Drew: Both Figure 9a and Figure 9b from Dahan, Ely and John R. Hauser (2002), "The Virtual

Customer," Journal of Product Innovation Management, 19, 5, (September), 332-354.

Figure 9. Web-based Product Demonstration and Pairwise Tradeoffs for a Camera

(a) Product Features   (b) Paired-comparisons

User design. The interactivity of the web coupled with rapidly advancing computer

power makes it possible to explore creative methods to gather information on customers'

preferences. For example, Dahan and Hauser (2002) describe a method of feature-based user

design on the web in which respondents drag and drop their preferred features onto a design

palette that illustrates the fully configured product, as seen in Figure 10. As these choices are

made, tradeoffs such as between price and performance are instantly visible and updated, so the

respondent can interactively learn her preferences and reconfigure the design until an "ideal"

configuration is identified. The method includes full configuration logic, so that only feasible

designs can be generated (i.e., choices on one feature can preclude or interact with choices on

other features). User design provides an engaging, interactive method of collecting data on

customer tradeoffs.

Drew: Figure 10 from Dahan, Ely and John R. Hauser (2002), "The Virtual Customer," Journal

of Product Innovation Management, 19, 5, (September), 332-354.

Figure 10. User Design of an Instant Camera

Target Costing: Design for Manufacturing and Assembly (DFMA)

The final consideration in the 4th stage of the NPD process is the further minimization of the cost of the new product. Given the benefits desired by the customers, how can the costs be minimized? This is the question addressed in designing for manufacturing and assembly. Unit production cost is an important factor in the marketing success of a new product. Specifically, investments to reduce unit manufacturing costs can increase profitability through six possible mechanisms: (1) market share improvements due to lower prices, (2) primary market growth due to lower prices, (3) reduced channel costs due to greater volume, (4) quality improvements due to simplified designs, (5) "virtuous cycles" of learning due to higher cumulative volumes, and (6) strategic benefits due to competitive disincentives. While the first four reasons are self-explanatory, the other two need some explanation. Virtuous cycles of learning refer to the effects of experience. As companies produce and sell more, because of lower costs and hence prices, they collect more experience which in turn results in product improvements and/or decrease in costs.[14] The examples of integrated circuit chips are relevant here. The more the chips are made and sold the lower the unit cost. Finally, the strategic benefits due to competitive disincentives results because competitors are less inclined to enter the market if a large share is already rested by the incumbent firm. In short, marketers must work with their operations counterparts in the early phases of new product design to ensure that low costs are locked in early.

Dramatically reducing unit manufacturing costs for a broad array of products can be achieved primarily through part count reduction and simplification of the assembly process. Because cost reductions may require changes in the appearance or performance of the product itself if taken to extremes, marketing input, to the extent that it captures cost-benefit tradeoffs as

customers would make them, is invaluable to making these decisions. Unit manufacturing costs

for products competing in the same category (coffee makers) can vary greatly, holding quality

constant and standardizing for feature variation. While some of these cost differences may be

the result of local manufacturing economics or variations in plant efficiency, a significant portion

of the cost differences result directly from design decisions made early in the product

development process. Once these design decisions are frozen, reducing the excess costs that may

result from them is very difficult.

STAGE 5: PROTOTYPE DEVELOPMENT AND TESTING

In this last stage of the NPD process, the goal is to evaluate the designed and engineered

concepts so that any launch is likely to succeed. Having taken considerable input from potential

customers in terms of desirable features via techniques such as conjoint analysis, and having

conducted required analyses to determine engineering specs with techniques such as HOQ and

DFMA, in this last phase several prototypes (perhaps virtual) are developed and tested.   Recently,

Rapid Prototyping Methods have been developed. In essence, these techniques automatically

generate multiple technical solutions on a product concept theme. Marketing's role in this phase is

to simultaneously test multiple designs with customers. After such parallel concept testing is

conducted the "freezing" of the design can be considered.

However, at this stage very "realistic" testing is required. The NPD team needs to simulate

product acceptance in a marketplace where sales are affected by marketing variables such as

advertising, word-of-mouth, and sales force presentations. Furthermore, really new products often

stretch technology and customer comprehension of its benefits. For example, prior to the

development of the personal computer, word processing was done by professionals rather than by

virtually everyone, spreadsheet analysis was limited to a few financial professionals, and personal

finance was done with the checkbook rather than programs like Quicken. There was little demand for web browsers before the Internet became widely available and little demand for home networking before broadband capabilities were ubiquitous. Thus, in testing really new products and concepts it is often necessary to place potential customers in new information states with new perspectives on the world. One such approach of placing customers in a futuristic environment is called Information Acceleration (IA).

Information Acceleration

Figure 11 illustrates IA using a prototype electric vehicle. Customers view this vehicle on the computer, walk around it virtually, and even (virtually) open the hood, trunk, and doors. In addition, customers could "talk" to other consumers like themselves; interact with a virtual salesperson; and view advertising, mock-ups of consumer magazines, and other stimuli they would likely see when shopping for a new vehicle. Furthermore, they could be accelerated into the future with accounts of alternative future environments that are either favorable, neutral, or unfavorable towards electric vehicles. IA has been tested and validated in a number of other environments including medical equipment and durable consumer products.[15]

Figure 11. Example of Information Acceleration

Drew. Figure 11 from Urban, Glen L., Bruce Weinberg and John R. Hauser (1996), "Premarket Forecasting of Really-New Products," Journal of Marketing, 60,1, (January), 47-60.
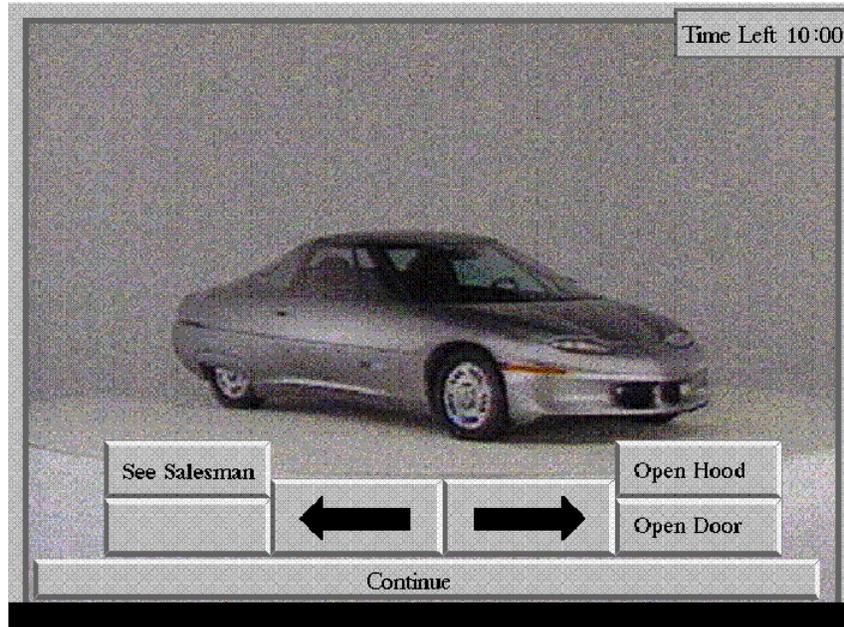
Pretest-Market and Pre-launch Forecasting

Once a firm has refined its product concepts, developed prototypes, and can produce its products in limited quantities, it needs to test the full benefit proposition that includes the physical product, service, distribution, and marketing actions such as advertising, detailing, sales force presentations, word-of-mouth, and publicity. We call such testing either pretest-market or pre-launch forecasting. In a typical pretest-market analysis, potential customers are shown products in a setting that is chosen to simulate the purchase experience. For consumer products they might be shown television advertising, magazine articles, tapes of other consumers talking about the product, sales force presentations, consumer magazine reports or whatever media are appropriate to the product category. They might be recruited at a mall, brought to a room to see advertising, then brought to another room that simulates a grocery store. They would be asked questions about perceptions, preferences, and purchase intentions and allowed to make an actual purchase in the simulated store.

In recent years the set of possible product categories has broadened tremendously with applications ranging from frequently purchased products (candy, soda, deodorants) to consumer durables (personal computers). In some situations, such as automobiles, the NPD team wants to test the market before launch, but after the production facilities have been built. Although volume is less of an issue, the team needs to know what it will take to sell the product. It needs an estimate of the required investment in advertising, dealer incentives, and promotion. To the extent that production is flexible, it also wants to know how many items it will likely produce with each set of features such as global-positioning and mapping systems, premium sound systems, or even metallic paint.

Mass Customization and Postponement

In some cases, the best strategy might be expeditionary marketing in which many products are placed on the market simultaneously allowing the market to decide which are fit to survive. However, expeditionary marketing only makes sense if the firm can easily ramp up production on the successful products and if the cost of failure is low (both directly and in loss of goodwill). The combination of efficient retailing (including e-commerce), product and process modularity, and flexible manufacturing systems are now making these conditions common in a variety of product categories. In particular, we are seeing an explosion in the sale of custom-configured goods that are only assembled after demand is observed. Perhaps the prototypical application of this system has been the build-to-order system used by Dell Computer to dominate the market for personal computers. The direct sales approach makes particular sense when obsolescence costs are high and "middleman" markups are significant, as in the PC business. In many cases a hybrid approach including make-to-order and make-to-stock is optimal. The optimal approach depends heavily on the nature of the product and the markets it serves. These

concepts represent a radical shift not only in manufacturing strategy, but also in the marketing thinking underlying product development. Specifically, once a firm adopts a mass-customization approach, the design problem shifts from searching for optimal bundles of features and optimal product lines to defining common platforms, features, and level options, component-by-component pricing and custom-configuration user interfaces. For example, by pre-sewing "white" sweaters in various sizes and delaying the dyeing of sweater yarns until after early demand has been observed, Benneton mitigates against the risks of overproducing unpopular colors or under-producing the season's "hottest" colors, while still being able to respond to demand quickly. Similarly, Hewlett Packard reduces its inventory risk by postponing differentiation of its printers based on geography (affecting power supplies and the language of the manuals) until very late in the distribution process. The manuals and power supplies are treated as separate modules to be inserted into the pre-manufactured, generic printer box. However, it is still vitally important that the PD team use the methods described earlier to winnow the concepts and features that are made available to the customer. Customers are limited in their ability to search among features – without some focus, even the best mass customization process might fail.

THE DIFFUSION OF INNOVATIONS

The process for a new product or service innovation to be embraced and adopted by a target market generally involves five stages: (1) awareness, (2) interest, (3) evaluation, (4) trial, and (5) adoption (or rejection). Given the significant time and resources that organizations invest in new product development, as well as the ongoing competitive pressures that they face, a key objective is to move a significant percentage of the firm's targeted customers through this process as quickly as possible. In other words, new products and services must not only succeed

(be adopted), but also succeed sooner rather than later. The issue is not only *will* the product

succeed, but also *how long* will it take the target market to become regular purchasers. The

marketer's challenge is to shorten the length of time between customer awareness of a given

innovation, and its wholesale adoption. Research into the diffusion of innovations has identified

at least five key characteristics of any product or service that significantly influence its rate of

adoption.

1) The greater the ***relative advantage*** of an innovation, the faster its rate of adoption. If

    the innovation delivers only a marginal improvement in utility or benefit to the

    customer, compared with substitutable products already available, the rate of adoption

    is likely to be relatively slow. On the other hand, if an innovation provides clearly

    superior features and benefits (such as when the introduction of cable television

    offered customers remarkably better picture reception compared with conventional

    antennae-based reception), demand may accelerate rapidly.

2) The greater the ***complexity*** of an innovation, the slower its rate of adoption.

    Innovations that stimulate significant initial demand are typically those that are not

    difficult for customers to understand or use. When the personal computer was first

    introduced, initial purchasers were mainly those individuals who were not intimidated

    by the complexity of the initial operating systems and their relatively "user-

    unfriendly" features. However, when Apple (and in turn Microsoft) introduced its

    much more user-friendly operating system, based on simple icons and English

    commands, demand increased dramatically.

3) The greater the ***compatibility*** of an innovation, the faster its rate of adoption. When a

    new product innovation is incompatible with existing products and services already in

use, or is incompatible with the basic systems and infrastructure already in place, its rate of adoption may suffer. When the compact disc (CD) player was first introduced, many music enthusiasts were unwilling or unable to enjoy its superior playback quality for a simple reason – these individuals' entire music collection was stored on vinyl records that were incompatible with this improved technology. On the other hand, when facsimile machines were first introduced, initial demand was intense – because the user simply plugged the machine into the existing electrical network, as well as the existing telecommunications network, and they were immediately able to fully capitalize on the advantages of this innovation.

4) The greater the *communicability* of an innovation, the faster its rate of adoption. When the results of using the innovation can be easily observed or described to others, rates of adoption will be greater. Clearly, the ability of a whole generation of young people to easily observe the advantages of innovations such as the Internet and cellular telephones has contributed to the astounding pace of growth for these two innovations. If an innovation cannot be directly observed by its intended target audience, its rate of adoption may be disappointing.

5) The greater the *divisibility* of an innovation, the faster its rate of adoption. This refers to the degree to which the innovation can be trialed by customers on a limited basis. Perhaps no one understood this issue better than AOL, as it distributed millions of free trial discs to potential internet service subscribers around the world. Consumers understandably prefer a risk-free trial of any product or service before adopting it.

The challenge for the NPD team is to develop product and service innovations that deliver a significant measure of relative advantage compared with competing alternatives, are compatible

with customers' existing values and experiences, are easily observed and trialed, while not being too complex for customers to understand and use. Unfortunately, poor performance on any one of these dimensions can suppress initial demand and jeopardize the success of the NPD team's efforts.

ORGANIZATIONAL ISSUES

We must not to overlook the human element in new product development. NPD tools and methods are used by individuals and groups *within* the organization. Because the new product development process is knowledge-based, people-based, and market-based, developing an organizational culture and a set of incentives and reward systems that facilitate successful new product development is critical. The organization must develop the capability and capacity to adapt, often quickly, to changes in the environment, market conditions, as well as to changes within the organization itself. Metrics and incentives must be designed so that NPD team members make decisions and take actions that are aligned with the best interests of the firm, and at the same time are responsive to the identified and the anticipated needs of its customers.

The success or failure of the new product development process depends heavily on the organization in which it is embedded. Unfortunately, many organizations struggle with the execution of the NPD process. One reason may be that new methods and priorities can cause shifts in the importance of people and their functions. A new tool or method can present an unwanted challenge to those team members who have previously enjoyed the rewards of being experts in the use of existing tools and methodologies. New tools and methods also can take time to learn and can divert attention and energy from the task of getting a NPD project out the door. If the benefits of the new tool or methodology are not immediately obvious and

measurable, then NPD team members may not have the incentive to invest their time and effort to use it now.

Overcoming the organizational challenges inherent in new product development requires establishing a clear emphasis on intercommunication. Differences and dependencies across organizational boundaries need to be recognized and understood by all NPD team members. Successful organizations create opportunities for such intercommunication by forcing team members from different parts of the organization to work together on a common problem or issue (sometimes referred to as boundary objects). For example, at Microsoft, disparate programmers from different organizational units are required to write software code for common programs (e.g., Microsoft Office). Each individual software component must work with the entire program – forcing intercommunication across the organization. Such opportunities allow NPD team members to learn different perspectives and terminology from each other. In some cases, the technical value of such boundary objects is less important than their ability to enhance communication among team members.

Another key element in the development of a successful NPD organization is to create a culture that not only rewards success, but also tolerates, if not encourages, a certain degree of failure. New product development is an inherently risky process. Any organization that routinely and thoughtlessly punishes failure, unless it involves an obvious deficiency in planning or execution, will undoubtedly stifle creativity and risk-taking over the long term. Occasionally, the time and effort invested in a new product failure can pay future dividends in terms of organizational learning and experience. Moreover, NPD teams that are conditioned to minimize risks and avoid failure at any cost will struggle to achieve substantial success in their new product development efforts.

Herb Kelleher, the charismatic founder of Southwest Airlines, understood the link between organizational culture and firm success. While the basics of providing airline services (planes, terminal space, baggage systems, etc.) are easily obtained by all of Southwest's competitors, Kelleher maintained that it was the spirit of Southwest, its corporate culture that set it apart. This organizational culture is also the hardest thing for Southwest's competitors to emulate or copy. According to Kelleher, if Southwest ever loses its unique culture, it will have lost its most valuable competitive advantage. Clearly, an area where a unique, customer-oriented culture can pay significant dividends is in the new product development process.

A FUTURE VIEW OF NEW PRODUCT DEVELOPMENT

Significant strides have been made in bringing a customer-needs perspective to the new product development process. Methodologies such as conjoint analysis have been used by many firms to systematically and rigorously examine customer needs and preferences, and incorporate them into the design of successful new product offerings. In the 21st century the challenges of new product development are changing as markets and competition became more global, as engineering and design talent became more geographically and organizationally dispersed, as internal product development efforts started involving a broader set of organizational units, and as information and communications technologies started changing the way people work. These new challenges call for a new product development process that is integrated, information intensive, almost instantaneous, and makes effective use of new technologies such as the internet.

An *integrated* new product development process requires that NPD teams be either cross-functional, or that they have the ability to make use of cross-functional knowledge embedded

within the firm. The design of the product, the assembly and manufacturing process, the entire marketing chain, and the marketing/promotional materials must all be integrated to provide outstanding value to the customer. As the process becomes more integrated, the demands for *information* will continue to grow. NPD teams must integrate information from the customer, the assembly process, the manufacturing process, the channel delivery process, etc. Speed-to-market has been proposed as a competitive advantage – at least if it can be obtained without sacrificing cost or customer satisfaction. Web-based methods have the potential for NPD teams to have their customer-preference questions answered almost *instantaneously*. In fact, it might soon be possible to obtain statistical information about customer wants and needs almost as fast as it used to take to debate them. Interestingly, in the future, the decision on how fast to introduce new products might be more of a strategic decision on product positioning rather than a decision constrained by the firm's ability to design and test them. And it is the set of information and communications technologies, best represented by the *internet*, that are enabling the process to be integrated, information intensive, and instantaneous.

KEY TAKEAWAYS

- New product development is risky, but that risk can be managed with an end-to-end, dispersed product development process.

- New products are developed through iterative stages of (1) opportunity identification and idea generation, (2) product concept development, (3) concept testing, (4) design and engineering of products, and (5) prototype development and testing.

- The greatest leverage in designing new products is in the early stages of the product development process.

- Successful new products are those that satisfy customer needs.

- Methods such as the voice of the customer, conjoint analysis, idea games, pretest markets, and the house of quality provide managers with the tools to develop products that satisfy customer needs profitably.

- Successful product development requires an organization that understands innovation.

<Please note that I added the appropriate references and a few footnotes, but I was not able to get the automatic endnoting working. I apologize. Hopefully, someone can fix this. If not, I can ask my admin asst to do it. Thanks. John H.>

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