The Impact of User-Oriented Design on New Product Development: An Examination of Fundamental Relationships*

Robert W. Veryzer and Brigitte Borja de Mozota

Design offers a potent way to position and to differentiate products and can play a significant role in their success. In many ways it is the focus on deep understanding of the customer or user—what may be termed user-oriented design (UOD)—that transforms a bundle of technology with the ability to provide functionality into a “product” that people desire to interact with and from which they derive benefits. Even though the importance of this type of design is gaining recognition, several fundamental relationships between user-oriented design contributions and the new product development (NPD) process and outcomes (i.e., product) remain unresearched, although they are assumed. This article examines the fundamental relationships underlying the incorporation of a user orientation into the NPD process. The discussion is organized around UOD’s impact in terms of enhancing collaborative new product development (process oriented), improving idea generation (process oriented), producing superior product or service solutions (product oriented), and facilitating product appropriateness and adoption (product oriented). Each of these is developed and presented in the form of a research proposition relating to the impact of user-oriented design on product development. The fundamental relationships articulated concerning UOD’s impact on NPD form a conceptual framework for this approach to product design and development.

For practitioners, the article suggests how user-oriented design can improve NPD through its more grounded and comprehensive approach, along with the elevated appreciation of design challenges and heightened sense of possibilities for a product being developed. For scholars, the article identifies four important areas for UOD research. In addition to the rich avenues offered for research by each of these, the framework presented provides a foundation for further study as well as the development of new measures and tools for enhancing NPD efforts.

Introduction

There is widespread recognition that as competition intensifies and technological differentiation becomes more difficult, design—specifically what is referred to as industrial design—offers a potent way to position and differentiate products (Borja de Mozota, 1985, 1990; Hayes, 1990; Hetzel, 1993; Lorenz, 1986). This, along with the trends of increasing product complexity and the aestheticization of everyday products, has made design an important element in the development of products (Borja de Mozota, 2003a; Bucci, 1998; Cova and Svanfeldt, 1993; Maffesoli, 1993). In fact, some leaders in the field of marketing have even proclaimed that “design is the factor that will often give a company its competitive edge” (Kotler, 2003, p. 321). Even with the acknowledgement of design as an

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important strategic variable, the topic of design has received relatively limited attention, and little progress has been made in furthering our understanding of the new product development (NPD) process with regard to this “potent” marketing variable. Traditionally, industrial design had been viewed as a service either within an organization or as contracted consulting rather than as a strategic business resource. However, the practice of industrial design has been evolving, as has the general context surrounding NPD. In today’s dynamic and competitive market environment, NPD managers as well as design managers have had to rethink how best to manage design and to integrate the various disciplines involved throughout the NPD process [e.g., marketing, marketing research, research and development (R&D), industrial design, engineering, and so forth].

The relationships among design, marketing, and other disciplines involved in NPD are complex, and how these functions are integrated in new product development can have a significant effect on the product that ultimately results from the process—and thus the product’s subsequent success or failure. Frequently, it is through the marketing and design disciplines (primarily industrial design, although not exclusively) that the product user’s perspective is infused into the NPD process. However, the challenge of developing successful products, embodied so as to enhance the user’s experience, requires an interrelational approach across all the key disciplines involved in NPD. Researchers (e.g., Norman, 2004; Veryzer, 1998) and practitioners (Kelly, 2001a; Vredenburg, Isensee, and Righi, 2002) have expounded on the merits of cross-disciplinary involvement that recognizes the importance of user-focused NPD. Typically, “user-centered” or “human-centered” design approaches are described as being primarily user driven or “outside-in” (Cagan and Vogel, 2002, p. 180; Vredenburg, Isensee, and Righi, 2002, p. 2). However, NPD these days often is driven as much by technological innovations in R&D labs that are in search of a product application as it is by a desire to satisfy established user needs.

Even with the broadening of the approach to design as more explicitly incorporating user–product interaction considerations, there remains a fundamental tension between a technology-driven and a user-oriented focus. In an era in which rapid technology cycles have accelerated the product life cycle to such a degree that (1) product applications often are formulated with only a partial sense of a market and that (2) products may become obsolete before there is an opportunity for refining or evolving them, there is little choice but to find ways to simultaneously suffuse these drives throughout the product development process. Here, the phrase user-oriented design is used to refer to sensitivity toward user/consumer design considerations in the context of extreme technology-based genesis and functional multiplicity/complexity of products. In adopting this phrase, it is not the present article’s intention to suggest that other researchers (e.g., Norman, 2004; Vredenburg, Isensee, and Righi, 2002) have not considered such issues; rather, this study seeks to expand on previous work and further to delineate specific design issues.

Even though in practice user-oriented design occurs in firm’s NPD processes—at least to some extent—and is handled better in some companies but not as successfully in others, there is much that is not well understood concerning its place and role in the product development process. In many instances, fundamental relationships concerning user-oriented design and its contribution to NPD are not well established even though they seem to be appreciated intuitively (at least in practice). This is due in large measure to the absence of research into these
fundamental relationships as well as the manner in which user-oriented design is diffused among disciplines (such as marketing and industrial design). This has left some key questions unaddressed, and the importance of these questions has grown for product developers as the importance of design as a strategic factor and critical element in the customer purchase decision process has increased.

This article examines the fundamental relationships underlying the incorporation of a user orientation into the NPD process. The article begins with a discussion of user-oriented design approaches and NPD. Then four research propositions are offered relating to the impact of user-oriented design on the product development process. These propositions represent fundamental research questions for advancing theory and practice in this area. Finally, some of the implications of this work for managers and researchers seeking to improve the process and outcomes of new product development efforts are discussed.

The NPD Process and User-Oriented Design

Design and the Development Process

The NPD process has been described as a sometimes “uneasy” integration of two interrelated segments: one that is primarily “technical” in character, and another that is “commercial” (Marsh and Stock, 2003; Rosenbloom, 1985). Over the course of the product development process, there are a number of disciplines that participate in the designing of a product. These include R&D, engineering, industrial design, marketing research, manufacturing, and so on. Some, such as R&D and engineering, are focused primarily on technical issues, while others such as industrial design and marketing are concerned with bridging from functionalities provided by the technology employed to delivering value in a finished and usable product.

The discipline of industrial design is described by the Industrial Design Society of America (IDSA) as “the professional service of creating and developing concepts and specifications that optimize the function, value, and appearance of products and systems for the mutual benefit of both user and manufacturer.” In the International Council Societies of Industrial Design’s (ICSID) view, “design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life-cycles. Therefore design is the central factor of innovative humanization of technologies and the crucial factor of cultural and economic change.” Depending on the stage at which they are brought into the process, the role of industrial designers can range from helping in the generation and ideation of innovative product concepts to defining and representing the form (inclusive of aesthetics) given to an emerging product. In very progressive firms and design consultancies (e.g., IDEO, Ziba, Smart Design) the practice of industrial design is deeply intertwined with NPD. Design is practiced holistically, with teams of industrial designers, engineers, and researchers skilled in ethnographic and observational research.

The product development process has been depicted and discussed by numerous researchers (e.g., Cooper, 2000; Crawford and Di Benedetto, 2003; Ulrich and Eppinger, 2004; Urban and Hauser, 1993). Table 1 shows a comparison between the classic Cooper (1998) Stage-Gate™ model and the different phases of the (generalized) design process as described by Ulrich and Eppinger (2004). Although in actuality the process is not always so easily broken into discrete stages, it can be instructive to examine it in this way. As indicated, each stage consists of a set of activities undertaken by people from different functional areas. Throughout the product development process, activities often occur in parallel, for example: concurrent engineering, industrial designers working with production engineers, and marketing researchers testing customer reactions to the various alternative design treatments. Even though the role of industrial design is rarely (explicitly) delineated in representations of the product development process, it is subsumed or implied in many of the activities that make up the process. However, the degree to which industrial design is integrated into the process varies across firms, and it is not unheard of for it to be treated as almost an afterthought or something that is “applied” once a product has been developed. With the prominence design has gained in recent years as an effective means for positioning, differentiating, and building the equity of brands, approaches to conducting NPD have become more inclusive—that is, industrial design has increasingly become a partner, albeit not always an equal one, in the development processes of many leading companies (Borja de Mozota, 2002; Hollins and Pugh, 1990).

In terms of how the different models describe the NPD process, each reflects a slightly different
Table 1. Phases of the New Product Development Process*

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<tr>
<td>Phase/Gate 1</td>
<td>Ideation</td>
<td>Exploration</td>
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<td></td>
<td>Initial screening</td>
<td>Consider product platform and architecture</td>
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<td>Phase/Gate 2</td>
<td>Preliminary investigation</td>
<td>Concept development</td>
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<td></td>
<td>Market assessment</td>
<td>Investigate feasibility of product concepts</td>
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<td></td>
<td>Technical assessment</td>
<td>Develop industrial design concepts</td>
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<td></td>
<td>Business assessment</td>
<td>Build and test experimental prototypes</td>
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<tr>
<td>Phase/Gate 3</td>
<td>Detailed investigation</td>
<td>System level design</td>
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<tr>
<td></td>
<td>Market research</td>
<td>Generate alternative architectures</td>
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<tr>
<td></td>
<td>Users needs and wants studies</td>
<td>Define major sub systems and interfaces</td>
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<td></td>
<td>Value in use studies</td>
<td>Refine Industrial design</td>
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<td></td>
<td>Competitive analysis</td>
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<tr>
<td></td>
<td>Concept testing</td>
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<td></td>
<td>Detailed technical assessment</td>
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<td></td>
<td>Manufacturing appraisal</td>
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<td></td>
<td>Detailed financial analysis</td>
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<td></td>
<td>(ends with business case)</td>
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<tr>
<td>Phase/Gate 4</td>
<td>Development</td>
<td>Detail design</td>
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<td></td>
<td>Product development (money gate)</td>
<td>Define part geometry</td>
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<td></td>
<td></td>
<td>Choose materials</td>
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<td>Assign tolerances</td>
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<td></td>
<td>Complete ID documentation</td>
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<tr>
<td>Phase/Gate 5</td>
<td>Testing and validation</td>
<td>Testing</td>
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<td></td>
<td>In house product testing</td>
<td>Reliability test</td>
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<td></td>
<td>Customer test of products</td>
<td>Life testing</td>
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<td></td>
<td>Market test</td>
<td>Performance testing</td>
</tr>
<tr>
<td>Phase/Gate 6</td>
<td>Market launch</td>
<td>Regulatory approvals</td>
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<td></td>
<td>Trial production</td>
<td>Implement design changes</td>
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<tr>
<td></td>
<td>Precommercialization business analysis</td>
<td>Production ramp-up</td>
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<td></td>
<td>Production startup</td>
<td>Evaluate early production output</td>
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<tr>
<td></td>
<td>Market launch</td>
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*Adapted from Borja de Mozota (2003a, p. 135).

orientation. Cooper’s (1998) Stage-Gate™ model presents more of a marketing orientation, while the process as depicted by Ulrich and Eppinger (2004) is somewhat more engineering oriented (although with explicit mention of industrial design). Such models have marked an increasing awareness of the importance of factoring intended users into the NPD effort. As products continue to embody progressively complex technologies and to offer a myriad of capabilities, it is often the user’s ability to understand and to appreciate the product that stands as a principal design constraint as well as being a key element in marketplace success. In this context of continual innovation and overwhelming product design possibilities, NPD processes need an effective means for informing the process with respect to the user orientation and all that this entails. However, the challenge goes beyond simply heightened reliance on market research and customer input, since these may not be adequate (or even appropriate) in cases involving the development of products beyond the range of customer experience (Leifer et al., 2000; Veryzer, 1998).

**User-Oriented Design**

Design approaches that focus on the user have been discussed by various researchers using different terms such as human-centered design, customer-centric design, and user-centered design (UCD). As Vredenburg, Isensee, and Righi (2002, p. 20) relate, “Because the term UCD has been used to describe a generic approach to product development, many flavors of UCD exist in the industry. Most current versions of UCD . . . have their origins in the seminal work of Norman and Draper (1986).” In delineating their conception of UCD, Vredenburg, Isensee, and Righi (2002, p. 20) explain, “We tend to use the terms user and customer interchangeably. The centered part of UCD refers to the fact that aspects of UCD revolve around one center, the user. The design in UCD refers
to the creation of the total customer experience. The D part of UCD can also stand for discovery, definition, development, and delivery.” Table 2 shows how Vredenburg, Isensee, and Righi (2002, p. 2) contrast user-centered design with the traditional approach.

Other discussions of user-oriented approaches emphasize various aspects of the approach. For example, in his most recent work, Norman (2004, pp. 92–93) points out that “to the practitioner of human-centered design, serving customers means relieving them of frustration, of confusion, of a sense of helplessness. Make them feel in control and empowered.” Other approaches reflect a particular attention to human factors, user experience, “usability,” and so on (Cagan and Vogel, 2002, pp. 174–181; Donoghue, 2002, pp. 3–34; Vredenburg, Isensee, and Righi, 2002, pp. 20–57).

The products that new technologies give rise to frequently require changes in thinking and customer–product usage behavior. “Innovation is essentially about change, and diffusion is essentially consumer willingness for change. Fundamental to the change brought by product innovation is how the new offering will interact with the actual needs and desires of consumers” (Veryzer, 2003, p. 851). In developing new products, both the technology employed and the likely customers for the emerging new product may prove insufficient as guides for determining design. Although each may help with certain design decisions, technology push may lead to product solutions that fail to match with customer needs (Vredenberg, Isensee, and Righi, 2002), while reliance on customer input (e.g., market/customer research) can be problematic (Leifer et al., 2000) and even may undermine innovation (Christensen, 1997). Even so, the design challenge is to integrate the various technological components into a system that is consistent with existing or evolving consumer usage patterns and needs.

In this, UOD can provide an orientation that fosters a deeper appreciation of user needs and what delivers value to customers. Sensitivity to aspects underlying customer/user reactions to products can have a significant impact on both the direction that product development takes as well as the eventual success of the final product. For example, product experience attributes have been classified into four general dimensions: (1) operative (relating to utility or function); (2) comprehendative (relating to how a product is comprehended); (3) constructive (relating to product structure); and (4) desiderative (relating to desirability and valuing of a product). They can be helpful in determining avenues for addressing design challenges posed by novel or extremely complex products (Borja de Mozota, 2003, pp. 110–111, as originally discussed in Veryzer, 2000). An understanding of a product in terms of a set of user experience dimensions can facilitate NPD by guiding the effort according to “properties” (e.g., universality, discovery, adaptability, appropriateness) to be delivered by a product as well as the means for delivering them. It is these sorts of qualities that consumers desire in the products they buy, regardless of the technologies incorporated into a product and whether or not they (intended users or prospective customers) are able to articulate the qualities themselves. Thus, UOD can provide a frame of reference that is capable of serving not only to guide development efforts in terms of the “metric” that ultimately matters most—user experience—but that also may affect the range and type of new product solutions that are conceived, evolved, and produced.

The movement toward placing a greater emphasis on the user as the focal point of design—something that is consistent with the shift from “production” and “sales” orientations of marketing to the modern day “marketing concept”—has had a significant impact on NPD. Evidence of this can be seen in the

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Table 2. Comparison of User-Centered and Traditional Approaches

<table>
<thead>
<tr>
<th>Traditional Approach</th>
<th>User-Centered Design</th>
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<tbody>
<tr>
<td>• Technology driven</td>
<td>• User driven</td>
</tr>
<tr>
<td>• Component focus</td>
<td>• Solutions focus</td>
</tr>
<tr>
<td>• Limited multidisciplinary cooperation</td>
<td>• Multidisciplinary team work</td>
</tr>
<tr>
<td>• Focus on internals architecture</td>
<td>• Focus on externals design</td>
</tr>
<tr>
<td>• No specialization in user experience</td>
<td>• Specialization in user experience</td>
</tr>
<tr>
<td>• Some competitive focus</td>
<td>• Focus on competition</td>
</tr>
<tr>
<td>• Development prior to user validation</td>
<td>• Develop only user validated designs</td>
</tr>
<tr>
<td>• Product defect view of quality</td>
<td>• User view of quality</td>
</tr>
<tr>
<td>• Limited focus on user measurement</td>
<td>• Prime focus on user measurement</td>
</tr>
<tr>
<td>• Focus on current customers</td>
<td>• Focus on current and future customers</td>
</tr>
</tbody>
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a Adapted from Vredenburg, Isensee, and Righi (2002, p. 2).
increased attention to industrial design as reflected in a wide range of products from computer equipment such as Samsung’s SyncMaster LCD monitor and industrial products like the Argus 3 Thermal Imaging Camera to appliances like the ASKO D3000 Dishwasher Series and personal care products such as Comfort Care (magnifying) Nail Clippers. However, even though progress has been made, the context in which NPD occurs remains challenging—particularly with respect to the tensions between such things as the need for innovation, the rapid rate of technological change, the need for deep customer understanding, product complexity and multiple functionality, maximizing customer experience, and value proposition (which can involve such things as usability, product performance, product support, product compatibility, and so forth). Addressing these concerns requires a process that benefits from the interplay between user-oriented and technology-driven forces as shapers of products. Further, as crucial as it is to uncover latent customer needs and to develop deep insights (Day, 1990; Narver, Slater, and MacLachlan, 2000), an important aspect of NPD today can involve proactively driving a market (Kumar, Scheer, and Kotler, 2000; Markides, 1999). Given the ever-accelerating rate of technological leaps—and the products they can spawn—a user-orientation is essential if the product outcomes of NPD are to be embraced by customers.

Although existing models of new product development have served us well, it is essential to continue to develop and to expand them in order to fully reflect the changing realities of the context in which product development occurs. Along with the diffusion of technologies that can allow increased product functionality (as well as the achieving of greater parity among competitive product offerings) have come pressures to improve the processes for conceiving and developing products. This has naturally led to an interest in how the “design factor” may be enhanced in order to offer a greater competitive advantage. A key to better and more consistently delivering on the promise that design offers is to understand its impact on the NPD process and outcome. Given the importance of understanding and managing design’s contribution to the NPD effort, it is worthwhile to examine some of the fundamental relationships of user-oriented design approaches as a first step toward their systematic investigation. Further, as is so often the case in areas relating to industrial design, research has been hampered by a lack of delineation of the critical issues and relationships requiring investigation.

User-Oriented Design and New Product Development

In the section that follows, four research propositions relating to the impact of UOD on the product development process are discussed. The first two propositions are process related in that they are concerned with how information is integrated when applying UOD and how this integration enhances the NPD effort. The second two propositions are product related in that they focus on how UOD can help produce exceptional products that will be successful when introduced into a market.

Enhancing Collaborative New Product Development

Focusing and orchestrating the activities that make up the product development challenge are inherently difficult. Disparate disciplines, each with its own emphasis and sense of “product direction,” have overlapping and sometimes conflicting areas of concern with respect to a product being developed. In order to promote a more constructive and effective NPD process—and to produce a more satisfying product (design) outcome—there are a number of aspects relating to user-oriented design to consider. These range from ways for integrating information and promoting cross-functional communication to developing and representing new levels of understanding a design problem/solution. Discussion of several of these considerations and how they pertain to building a more collaborative NPD process follow.

In NPD there is a need to address two aspects that make up the whole of the product development challenge (Clark and Fujimoto, 1990). The first of these is internal integrity or consistency among the structures and functions of the product itself and between formal and informal information affecting its development. The second aspect of the product development challenge is external integrity, which refers to the match between the product and the intended user and involves managing the information flux from the market toward those responsible for concept generation and embodiment. Integration of user-oriented design into the development process may positively impact both of these aspects of the NPD effort by introducing different and typically unfamiliar perspectives into the approach undertaken for the product development challenge, thus leading to a higher level of “collective creativity” (Maltz, Souder, and Kumar, 2001). As
Fujimoto (1991, p. 30) states in a study on the automotive industry, “Another feature evident in corporations that exploit the ‘designer-as-integrator’ strategy is an orientation to customer satisfaction in the form of total product integrity.” Information integration is key to effectively dealing with external and internal integrity. User-oriented design promotes information integration by providing a crucial fixed point toward which the efforts of each of the professions contributing to product development can focus. In so doing, a better sense of the “product”—including the key assumptions influencing its development direction—can occur as it moves toward an embodiment.

Cooperation and communication between R&D and marketing functions increase chances of success (Griffin and Hauser, 1996) and are integral to streamlining the NPD process. As has been discussed, the design process is in essence a cross-functional process in terms of the inputs required—integrating constraints from R&D, marketing, manufacturing, engineering design, and industrial design. Particularly important are the links between R&D and the other functional groups such as marketing and manufacturing (Zirger and Maidique, 1990). One critical reason for a strong link between disciplines that tend to drive the front end of the process for today’s complex and innovative products and marketing is to ensure that the firm understands user needs and effectively translates these needs into solutions for the customer (Zirger and Maidique, 1990). This is essential since it is paramount that new products provide significant value to the customer. As Zirger and Maidique (1990) conclude from their study, value can be measured in several ways, including superior technical performance (a characteristic of many of the successes in their sample), a lower cost design (one that allows pricing the product lower than competitive alternatives), or a set of unique features. Regardless of which one or combination of value propositions a new product offers, a process that encourages explicit and deep consideration of customer needs is likely to stand a better chance of producing a successful outcome.

As the design challenge has intensified, the means for understanding and infusing knowledge about users into the NPD process has evolved. Designers always have been valued for their observation skills, but what is changing now is that these skills are more research based. As Cagan and Vogel (2002, p. 183) relate, “Most recently, techniques used in the field of anthropology have been employed to aid in the pre-

liminary stages of new product development through the use of ethnographic methods. Traditional ethnography is the art and science of describing a group or culture. It is a form of cultural anthropology using fieldwork to observe the group and derive patterns of behavior, belief, and activity.” Cagan and Vogel (2002, pp. 185–186) go on to discuss observation (being physically at an event or using video and sound recording for later analysis), interviews (collection of deep stories that detail the way people think about products and relate them to their lifestyles), and visual stories (narratives created by participants via disposable cameras and journals where the target users themselves record what they think is important in a defined setting). The data collected through such techniques are shared among innovation team members and provide a better sense of end user intent.

Companies always have tried to understand their consumers by conducting primarily product-focused or culture-focused research. More recently, a new type of customer research has begun to emerge in the design community that is activity focused. “Activity-focused” research methodologies, which rely on video observations of user interactions and video ethnography (Kumar and Whitney, 2003), provide databases relevant for many types of design projects. Digital ethnography, which capitalizes on wired and wireless technologies to extend ethnographic methods like participant observation beyond geographic and temporal boundaries (Masten and Plowman, 2003), is a technologically driven evolution of traditional ethnographic methods. Hypermedia ethnography, which draws heavily on electronically based media to infer meaning, and cybersociology, which involves the study of Internet-based interactions, show potential for increasing insight into user experience/needs, interaction between customers and products (or services), and brand transformation. Philips calls this new paradigm “transformation through experience” (Moore, 2002).

Visualization becomes a valuable tool for communication between project team members and for coordination as well as decision-making. Visualization involves transforming “personas” (representations of behavioral and motivational aspects of target users) and use scenarios of target customers into a more tangible (product) form. An important part of design in general and certainly of UOD involves using of roughs, mock-ups, and prototypes at different points of the NPD process. “Models often surprise, make it easier to change your mind, and accept new ideas”
(Kelley, 2001a, p. 111). “Give your management team a report and it is likely they won’t be able to make a crisp decision. But a prototype is a spokesperson for a particular point of view, crystallizing the group’s feedback and keeping things moving. At IDEO we have found that a good prototype is worth a thousand pictures. Good prototypes don’t just communicate, they persuade.” (Kelley, 2001b, p. 39).

The enhanced collaboration effect of integrating a more complete perspective throughout the development process is echoed by researchers. For example, Thomke and Fujimoto (2000, p.140) have stated, “We introduce the concept of front-loading problem solving which we define as a strategy that seeks to increase development performance by shifting the identification and solving of design (inclusive of the user) problems to earlier phases of a product development process.” Renault provides an example of how this approach is being used. In order to help maintain creativity upstream in the innovation process, the option of “design fundamentals” forums that explore essential design issues is used to provide a means for innovation that overcomes the barriers between engineering and industrial design. At Renault this has been organized under the name of “design fundamentals process.” They are “transversal” in their objective in that they cut across disciplines in examining a problem and can be, for example, a workshop held by industrial designers that investigates the problem of light in the car cockpit. Without this transversal approach the sensorial impact of light is divided into parts and components, thus missing its holistic impact on various aspects of a design—such as vision, comfort, and the interactions of the car with its environment, the effects of different materials used for seats on light quality, and so on (Hirt, 2003). The overall final pleasure for the user requires such issues to be investigated ( approached) globally rather than as subsystems of components or as the exclusive domain of any particular discipline.

UOD helps to overcome integration barriers by its “transversal” nature and by using physical representation as a communication tool aimed at creating a common context that acts as a sort of touchstone for a project. “Physical representation of the product under development spans the language boundaries between disciplines. Such models represent ‘the emerging product in a reasonably neutral language’ and ‘are important as boundary objects in that they serve as visible, accessible symbols of the finished product, helping to unify the design team” (Leonard-Barton, 1991, p. 64). Visualization and rapid prototyping are the most valued tools to this end and give a holistic perspective to the project that can help in building consensus over the course of a development project. Along with this, a key effect of employing a user-oriented design approach is the propensity of such orientations to foster metrics that are shared across an enterprise (Donoghue, 2002, pp. 39–43). Shared metrics allow each distinct group involved in the NPD process to appreciate both its own contribution(s) to the overall user experience as well as those of the other disciplines involved (Donoghue, 2002). Ultimately, this further promotes cooperation and information integration.

The effects of the information integration that occur through incorporating user-oriented design into NPD and its impact on the process thus may be stated:

Proposition 1: Greater emphasis on user-oriented design will induce a more collaborative new product development effort.

Although it is not a simple matter to be more inclusive and participatory with respect to disciplines that help to instill a user-oriented design focus, there is reason to believe that the net effect would be worth the effort. The sort of awareness and appreciation that can become built into the process may reduce the time for design (engineering design, ID, packaging design) and may minimize redesign work (Borja de Mozota, 2003a; Kessler and Chakrabarti, 1999; Veryzer, 2005). With this there is a leverage effect—each functional area feeding into the others in a more shared context.

Enhancing Idea Generation

Many companies have formal procedures for generating new concepts involving such things as interviews of experts in various scientific contexts, qualitative marketing research on emerging social trends, and so on. Regardless of exactly how it is approached, there is an attempt to understand, to foresee, to anticipate, and to determine what should be in terms of the next product using a lateral thinking process. Although concept generation would seem to require an appreciation of both technical capabilities and a clear sense of user needs, in practice this often is not the case—particularly for technology-driven products (Ulrich and Eppinger, 2004). In contexts where technological innovation is the primary driver of a new, discontinuous product,
sensitivity to user-design issues tends to significantly lag the development effort (Veryzer, 2005).

In the ideal, the NPD process integrates creativity and ideation with two ends of the spectrum: (1) upstream with “prospective” marketing and advanced design that defines concepts (abstract promise); and (2) downstream with operational marketing and product design that makes a concept live in the mind of the consumer (e.g., experience design, product image, brand image) (Borja de Mozota, 2003a). Idea generation requires a high level of integration between the internal and the external as well as among the customer, the concept, the product, and production considerations (including suppliers) in order to produce a number of promising ideas. Toward this end, user-oriented design can enhance idea generation in three important ways: visualization/conceptualization, form alignment, and transmutation of the design challenge.

First, UOD can aid in envisioning various possible design directions and thereby can push thinking beyond the usual range for a given or developing product category. In part this comes from continual referral back to the user experience as the principal focus, and in part this stems from an emphasis on visualization. As discussed earlier, an important part of fostering user-oriented design involves the use of renderings, mock-ups, and prototypes. These are used at different points of the process by various companies, with firms like Braun using them very early in the process. “Prototyping doesn’t just solve straightforward problems . . . Call it serendipity or even luck, but once you start drawing or making things you open up new possibilities of discovery . . .” (Kelley, 2001b, p. 38). Often the designer’s ideas will be developed into scenarios for the future, as is done by the furniture firm Herman Miller (Long, 2002). In this way, UOD can result in pushing the envelope in terms of solutions that are beyond the familiar range of likely solutions, even to the point of the seemingly infeasible, and thus can help a project team arrive at more innovative design solutions.

Form alignment with user needs and values is another way that UOD may enhance idea generation. Through considering and recasting problems/products in terms of relevant user experience dimensions such as universality, ergonomics, and aesthetics, innovative solutions may emerge. Products such as the Aeron Chair by Herman Miller, Black & Decker’s Snake-light™, and OXO® kitchen tools reflect a user-oriented predominance in their designs. In these products, solutions were derived based on focusing on and meeting user needs—and because of this the solutions generated are both innovative and extremely effective. By keeping the development process grounded in the users’ experience as a primary consideration, technology can be incorporated into forms that provide maximum benefit to product users. UOD encourages this sort of “technology humanization” through promoting ideas that are aligned with peoples’ needs and in so doing can enhance and elevate the quality of idea generation.

Finally, user-oriented design can act to federate all the players involved in idea generation around a common objective turned toward the intended customer. Through this UOD encourages intensive and precious communication among the players involved in the NPD effort, and this cross-communication can challenge assumptions or can shatter conventions. Ultimately, this can result in transmuting or evolving the entire design challenge by redefining the “problem” and reorienting approaches directed toward addressing it. The outcome of such a shift can be to elevate the understanding of the design challenge to a higher level—one that will result in producing a design solution that better serves the needs of intended product users. This is a principal reason Toyota has made a systematic effort to front load the development process in order to shift (enhanced) problem identification to earlier stages of product development (Thomke and Fujimoto, 2000).

Integration of a user-oriented design process—with its use of scenarios, visualization, experience dimensions, and so on—may positively impact the overall NPD effort, thus leading to a higher level of “collective creativity” (Maltz, Souder, and Kumar, 2001). This, along with the interplay of disciplines that are each orienting their expertise toward delivering maximum value to the user, spurs the generation of creative solutions that are beyond the possibilities likely to be generated by less user-oriented approaches (Donoghue, 2002).

The impact of UOD on idea generation may be stated formally as follows:

Proposition 2: Integration or inclusion of user-oriented design in new product development will have a positive effect on idea generation.

The Impact of User-Oriented Design on Product/Service Outcomes

UOD involves balancing commercial concerns (e.g., target marketing, price points) and market realities with delivery of a set of capabilities or functionalities
in the form of an integrated “product” that is both pleasant and effective to use. In promoting an ardent orientation toward the customer and deep understanding of user needs, UOD can operate to keep the NPD process grounded and on track for delivering products offering the exceptional customer value necessary for firms to execute strategies and to achieve their objectives.

It is not uncommon for management to have difficulty in evaluating product opportunities and committing resources in the face of questionable business projections—assessing and predicting the potential of some of these product opportunities can be quite challenging. “Linking enduring customer needs with what is made possible by new technologies appears to be a difficult task . . . thus, the inability of potential customers to articulate the required functionality and benefits of a proposed new product creates uncertainty for the marketer trying to bring a new product through the NPD process. Reducing the uncertainty to such an extent as to be able to identify the best target market for technologically driven innovations and to have confidence in the proper mix of the product’s functionality, human interface, pricing, and market positioning is extremely difficult and sometimes nearly impossible” (Mullins and Sutherland, 1998, p. 228). “The uncertainty of consumers as to the fit between a proposed new product concept and their needs makes concept testing problematic” (Mullins and Sutherland, 1998, p. 230). Thus, in the challenging context surrounding NPD today, the use of prototyping to deal with this and qualitative marketing research techniques is more necessary than perhaps it has been in the past (Mullins and Sutherland, 1998).

Another way that UOD plays a role in the design process is through an understanding of cognitive and behavioral processes (Norman, 2004). These processes have been shown to underlie people’s reactions to and preferences for products (Veryzer, 1993; Veryzer and Hutchinson, 1998). This linking of the impact of design or design elements to sales impact is important for guiding a firm’s design efforts. This impact has been documented largely in studies that also provide evidence of the impact of design on exports and market share increases (Rothwell and Gardiner, 1984; Roy, 1990; Sentance and Clarke, 1997; Walsh, 1995). For example, consumers have aesthetic preferences, and their preferences and opinions vary according to perception of the quality of design as well as in accordance with design principles (Damak, 1996; Magne, 1999; Veryzer, 1993; Veryzer and Hutchinson, 1998). Affective response is what gives rise to emotions in the consumer’s experience, and it can be an important component in the success of a product (Bachmann, 2002; Moore, 2002; Mulhern and Lathrop, 2003; Stompfl, 2003). Designers work on the quality of sensations—arranging aspects of a product such as color, texture, and materials—in order to effect reactions across the various visual, tactile, olfactory, and auditory senses (Long, 2002; Schmitt, 1999; Veryzer, 1993). Thus, the product is communication and stimulation: the quality and the originality of the shape conveys a message that fits the themes of modernity and the semiotics era (Baudrillard, 1981; Dano, 1994). Product appearance helps the selection process during the act of purchasing; it also helps in product categorization. The form and cues given to a product communicate important information to consumers. The outside appearance or “form design” of a product or brand affects the consumers beliefs and knowledge about products they encounter. To at least some degree, consumers evaluate the quality and the performance through the outside appearance of a product (Zeithaml, 1988). This is true for consumer durable goods like electronics and automobiles, package goods products due to the impact of packaging design, and even many industrial goods (Yamamoto and Lambert, 1994).

Beyond these more tangible aspects, UOD encompasses experiential aspects of the products that firms wish to create. Consumers are in search not only of products and services that fit their needs but also of products and services that surprise them and that generate a total “experience.” This emotional side of consumer behavior has been well documented in the experiential model of consumer behavior (Bitner, 1992; Hirschmann, 1983; Holbrook and Hirschmann, 1982).

Although products are developed through the combined efforts of all the disciplines involved in NPD (e.g., R&D, engineering, marketing, ID, manufacturing), it is usually through work such as market research that the brand promise and brand positioning are shaped, and these ultimately inform the design direction taken in new product development or product repositioning. Designers, as they strive to embody technology and functionalities into a product form, draw on the insights generated through customer research and market analyses. Building on these and adding their own expertise, designers build an identity consistent with the product or market opportunity and brand (Borja de Mozota, 2003b; Briggs and Dorjadt, 2001; Gobe, 2001).
Even while some of these aspects of a product may sound almost ethereal, they can translate into important factors in a product’s longevity and success. Products such as Harley Davidson motorcycles, Ferrari automobiles, Eames chairs, and Apple computers all seem to be imbued with a nature or quality that goes beyond the materials of which each is constructed. In some cases, as with Harley-Davidson motorcycles, the design of a product and what it gives rise to can help to create a sense of community around the product consumption experience—and in the extreme, what is important for the consumer is not goods per se but their potential for providing a relationship and networking: the concept of *valeur de lien* or relational value of a product (Cova, 1995). Aesthetics in our postmodern world are sometimes understood as shared emotions, and the product as “object of cult” transforms the product into societal innovation or into a means of introducing significance in the social system. The comprehensive nature of UOD is particularly suited to help create new products that will reconcile the paradox of the necessity for arousal and pleasure with peoples’ need to relate the products they encounter to existing brain patterns so that they may be comfortable with an innovation.

Thus, a proposition conveying the general expectation concerning the impact of user-oriented design approaches on the product outcome of the development process may be stated as follows:

**Proposition 3:** Integration or inclusion of user-oriented design in the new product development process results in a superior product or service.

### Facilitating Product Appropriateness and Adoption

Innovation means new uses and new forms of products. New products, or new designs, require acceptance by consumers to be adopted. Designers are important arbitrators between the potential of technology and the needs of the user (Borja De Mozota, 2003a; Crawford and Di Benedetto, 2003; Ulrich and Eppinger, 2004). It is largely their role, in the context of the overall development effort, to translate and to interpret the functionalities and mechanisms that provide them into a product (Veryzer, Habsburg, and Veryzer, 1999; Ulrich and Eppinger, 2004). The deeper insights gained about consumers that come with user-oriented design approaches, along with the ability to ascertain reactions to visual representations of proposed products, provide product development teams the best opportunity to identify negative design issues and gauge customer reaction.

User-oriented design is extremely useful for the emergence of new technologies, with much of its contribution stemming from the outcome (e.g., understandability, ease of use) in terms of promoting product acceptance or diffusion (or in the aggregate, societal acceptance of technologies). Innovations take time to diffuse through the social system (Rogers, 2003), and products developed with a strong focus on the user are likely to be embraced more easily and readily by the customers for which they have been designed. For example, adoption likelihood may be enhanced through design that addresses crucial attributes. Rogers (2003) points out that from 49 to 87 percent of the variance in the rate of adoption of innovations is explained by five attributes: relative advantage, compatibility, complexity, trialability, and observability. Success in designing each of these attributes into a product is dependent on a deep understanding and sensitivity concerning users, as well as maximizing the productivity of the interplay (i.e., information exchange) between disciplines involved in the NPD effort that UOD promotes. New technologies provide so many possibilities but are only likely to emerge as a success if they are designed so as to be consistent with users’ evolving needs—and often this requires anticipating the future. As has been pointed out, an innovation’s design is more easily integrated into people’s minds and lives when constructed so as to evoke a shared experiential vocabulary and pre-existing understandings (Hargadon and Douglas, 2001; Veryzer, 2000). Prospective innovators need to carefully cultivate designs that assimilate some elements of the familiar, along with novel features, into new product embodiments that can be readily interpreted and are willingly embraced.

Thus, the impact of user-oriented design in facilitating product adoption may be stated more formally in the following way:

**Proposition 4:** Inclusion of user-oriented design leads to products that are more readily adopted by users due to better product appropriateness.

Proposition 4 is related to the previous proposition in that both refer to UOD’s resulting in a more desirable product outcome than otherwise would be the case. However, here the emphasis is on addressing inhibitors/promoters of product adoption, whereas Proposition 3 is more focused on UOD’s overall effect in fostering a better product outcome.
User-Oriented Design Impact on New Product Development

This article has articulated fundamental relationships underlying user-oriented design approaches as they impact NPD. These relationships fall into two general categories: process related and product related (Figure 1). As summarized in Figure 1, UOD increases collaboration through enhancing integration and providing a common point of reference for the disparate disciplines involved in NPD. Idea generation may be improved due to the heightened innovation that comes with simultaneous consideration of constraints and resultant solution efficiency. The impact of UOD on the NPD process affects product outcome in terms of the superiority of solutions and their appropriateness for customers. The deeper, more complete appreciation for users allows for the development of product solutions that offer more value as well as cognitive and experiential benefits. Product desirability and potential for success also are increased through attention to technology translation and adoption characteristics.

Models such as the Stage-Gate™ model of innovation are very useful but have not completely captured the impact of dynamic user-oriented design throughout the NPD process. Figure 2 summarizes graphically the relationships inherent in user-oriented design approaches. As can be seen in Figure 2, some of these relationships (e.g., P1, P3, and P4) are in a sense cumulative in that they are affected by multiple development stages. Thus, the propositions for these relationships might be broken down and examined with respect to each development phase (including linkages and transfers). In contrast, Proposition 2 would seem to be somewhat more directed toward a specific phase or linkage between two phases. However, there are a number of possible variations with respect to this. For example, if a new product is R&D driven, industrial design may not be involved at the inception of the idea, but industrial design may play a key role in enhancing the idea and the creative design solution during the subsequent stages.

A model such as the one implied in Figure 2 is consistent with translation theory (Callon, 1986; Latour, 1987) and sociological models (Ackrich, Callon, and Latour, 1988) of innovation in their broader implications for NPD. For example, translation theory defines the conditions for the production and the circulation of technical innovations. It stresses the fact
that in elaborating innovations the frontiers of the firm and the building of the innovation network are often necessarily ignored. In this, the “touchstone” must be something other than what a firm has known. Similarly, it explains the importance of “translators” from engineers to consumers and users. This is already evidenced in practice with high-technology companies and the R&D laboratories of organizations like the Rank Xerox Parcor in France and France Télécom Studio Créatif asking industrial designers to help them materialize the potential of the technology developed by their (R&D) efforts into product concepts (Borja de Mozota and Roa Seiler, 2003). Therefore, managing innovation implies extending relations and associations beyond the space of the project team. It means the integration of different categories of “actors” with different rationalities in the NPD process. It goes past organizational frontiers in order to completely integrate disciplines (e.g., experts in human sciences like sociology or anthropology in addition to industrial designers and marketing researchers) into designing the user experience that innovative, high-tech products become.

**Implications and Conclusions**

*Design Performance and Strategy*

The underlying supposition for the relationships catalogued here is that a user-oriented design emphasis not only can contribute to the NPD effort but also can serve as a focal driver of that effort. Such a focus offers the potential to contribute to design performance in several important ways. User-oriented design can provide better appreciation of the challenge and heightened sense of the range of possibilities for a product being developed. It can help to ensure that both the realities of the application (e.g., customer product use/needs) and the realities of the market are addressed. In addition to resulting in a product more in tune with the customers toward which it is targeted, incorporating UOD as a focal driver can produce a more comprehensive approach toward NPD—and this can result in cost savings due to things like reductions in redesign work and heightened design for manufacturability, as well as shortening the length of the NPD process. It also can keep a development project on track and grounded, in touch constantly with the ultimate objective of any development project—to provide real value in the form of a well thought-out and designed product that provides maximal utility to the user.

A user-oriented design focus can be important for achieving a firm’s strategic goals. There is a relation between strategy and design since design serves as a primary means for executing a given strategy. This relationship between design and strategy can even extend to such things as how a firm operates with respect to technology. For example, if a firm’s strategy capitalizes on technology, then design strategy needs to be directed toward social acceptance of the technology. Depending on a firm’s technology strategy, the focus of design innovation will tend to differ: if the goal is (1) technological leadership, the design strategy will focus on creativity (and promoting product adoption); (2) a fast-follower policy, then design strategy will focus very intently on the users’ needs in order to provide a product that better satisfies customers than the category leader; and (3) “me-too” manufacturing, design, and so forth will be oriented to provide advantages with respect to the capacity to produce (Holt, 1991). As the success of firms such as IDEO and Ziba highlight, design acts as interface among the
firm, the customer, and society at large and plays an important role in technology transfer and adoption.

Implications for Research to Further Management Practice

Clearly, an important implication of this work for researchers wishing to contribute to management practice in this area is that each of the propositions outlined requires thorough and systematic investigation. The relationships presented in the propositions are fundamental to whether and how user-oriented design contributes to the product development process. Even though these are fundamental relationships and many seem apparent, the practices found across firms vary with respect to these relationships and thus represent either suboptimal processes or indicate situations where alternative practices are warranted—or perhaps each of these is sometimes the case. Nevertheless, the propositions need to be examined with respect to the degree to which they hold in different development contexts (for example, radical innovation versus redesign; in-house design versus contract design work) and for boundary conditions involving specific industries and product categories. To the extent practices vary, understanding when this is the case and how or why is fundamental to achieving a deeper understanding of NPD through more completely appreciating the roles that UOD plays and its interrelationships across various disciplines in providing critical perspective and metrics.

In addition to the abundant research challenges that fall under the set of propositions presented here, there are some related issues that merit further research attention. In order to adequately research user-oriented design’s impact on the new product development process and its outcomes, specific measures will be required to accurately assess the relationships as they occur in firms. Refining or developing such measures requires recognition of the relationships here if the full impact of design is to be understood and documented. For example, the degree to which user-oriented design that is integrated in the new product development process results in a superior product (or service) can be a function of its involvement throughout the process. As indicated in Figure 2, this means that the level of integration and the impact of the integration need to be measured for each stage of the NPD process and the cumulative effect of the involvement correlated with the outcome of the process. It is only through such comprehensive measures that the true nature of the relationships of interest can be ascertained.

Similarly, specific measures for each of the aspects of idea generation—visualization/conceptualization, form alignment, design challenge transmutation—also would seem to offer rewarding avenues for future research. Refining these components of the idea generation process can open doors for further study as well as the development of new tools for enhancing NPD efforts. Likewise, refinement of measures that more completely capture the impact of UOD on the outcome of NPD processes in terms of success relating to enhanced value offered by product solutions developed and increased product adoption would seem to offer significant opportunities for research.

Finally, an important challenge for researchers interested in this topic is to develop formal tools for better integrating the disparate disciplines and the unique perspectives each offers. These types of tools seem to be particularly lacking for bringing the user-oriented design considerations to the forefront of senior management thinking. This could be particularly helpful to heavily R&D-driven firms where a technology-push process has tended to be the norm. Pressure from senior management for efficient use of resources accompanied by a lower degree of tolerance for R&D with no foreseeable product application makes integrating the abilities of user-based disciplines like industrial design and marketing more of a necessity than ever before. Tools that facilitate incorporation of UOD throughout the product development process are likely to develop out of research that examines the propositions presented here as well as the measures required to investigate them. Thus, the framework as summarized in Figure 1, and its impact throughout the NPD process as indicated in Figure 2, offers a foundation for future empirical work and further development of models and tools. These could prove invaluable in advancing NPD practice and in enhancing the competitiveness of firms in an increasingly competitive environment.

Increasing our understanding of the new product development process is important if firms are to meet the challenges of global competition. By examining some of the fundamental relationships between user-oriented design and the new product development process, it is hoped that the challenges and opportunities for establishing more refined models of NPD are clearer and that these may lead to achieving a better balance among the economic, technological,
user, and aesthetics dimensions that provide value to customers in the form of innovative products.

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