USING TRIZ AND HUMAN-CENTERED DESIGN FOR CONSUMER PRODUCT DEVELOPMENT

Alan Van Pelt
Jonathan Hey

Berkeley Institute of Design
University of California, Berkeley
alanvp@jumpassociates.com
jono@berkeley.edu

Abstract
TRIZ is increasingly being applied to consumer product development, in which products have to solve more than just technical problems, they have to provide compelling solutions to consumer needs. This paper discusses the use of TRIZ together with Human-Centered Design (HCD), a design methodology evolved for consumer product development. Using a case study, we illustrate why understanding user needs in consumer product development is particularly important, and then compare TRIZ and HCD methodologies. To better understand the appropriate use of TRIZ in consumer product development, we present a framework of Use, Usability and Meaning. Design situations where the emphasis is on a product’s Use stand to benefit most from TRIZ methods, whereas for product areas with strong Meaning attached, HCD methods provide the most guidance. We finish by presenting some opportunities for successful integration of the two methodologies.

Keywords: TRIZ, Human-Centered Design, Consumer products, Use, Usability, Meaning

1. Introduction
TRIZ (Altshuller, 1984) has gained much commercial acceptance over the past decades, and can now be found contributing to product development in such multinational corporations as Samsung, Motorola, Xerox and others. This paper considers this expanding use of TRIZ within consumer product design (for example, Hipple, 2006; Jana, 2006) and its integration with a Human-Centered Design (HCD) methodology. We believe that just as HCD practitioners can benefit from the introduction of TRIZ methods, so too can TRIZ practitioners benefit from the introduction of HCD methods.

TRIZ largely focuses on the innovation of physical devices, yet it is human needs that drive people to buy products: the need to go quickly from point A to point B; the need to remain clean; the need to feel unique. While some needs may appear obvious to designers – the need to drink coffee on the move – others will remain hidden or dormant – the need to be perceived as a busy, caffeinated go-getter. Translating from individuals’ needs to TRIZ’s language of functions is a key, but tricky, step. We argue that successful consumer product development requires understanding subtle, below the surface factors such as human values, product meanings, and unspoken needs.

TRIZ was not developed to provide a deep understanding of consumer needs. Several TRIZ researchers, therefore, have made efforts to integrate TRIZ with other design methods and tools. Integration of the Voice of the Customer in the problem definition phase has been proposed (for example, Mann 2006), including the use of models such as the Quality Function Deployment (QFD) House of Quality. Others have proposed integration with the
Kano model (Runhua 2002) or Neuro Linguistic Programming to understand customers (Mann, 2002). Hipple (2006) interprets many consumer products from the perspective of the TRIZ methodology and Mann (2002) provides an extension of the classical 9-Windows tool to include consideration of behaviour, capability, and beliefs, values, and identity.

Each of these integrated methods, however, requires a well understood product space. They do not include a robust means of discovering the needs of a particular customer group and a framework for working with those needs. In contrast, Human-Centered Design is a design methodology emphasizing a deep understanding of users, a prototype often, and a fail-early-to-succeed-sooner mentality. Its “enlightened trial and error” approach contrasts with TRIZ’s emphasis on careful analysis to solve the right problem. Perhaps this explains why few designers actively combine the two methodologies into their design approach. The expanding application of TRIZ to consumer product development and the increasingly competitive nature of product design make their integration especially important now.

We begin by illustrating with a case-study how a thorough understanding of user needs during product development is critical to successful adoption. We then provide an overview of HCD and compare the methodologies side by side. Finally, we discuss the integration of the two methodologies by presenting a framework of Use, Usability and Meaning to determine when each is most appropriate.

1.1 Consumer Needs Over Technical Superiority: a Case-Study

In early 1975, Sony Corporation revolutionized the home entertainment market by introducing the BetaMax, a personal video cassette recording system that allowed users to record video from cameras or television. Nearly two years later, JVC introduced a competing technology known as VHS. While VHS had a recording time twice that of Beta’s one hour, most considered Beta to be the superior technology with higher video resolution and more compact cassette tapes. The Beta format enjoyed a large lead in the early 80s, but by 1985, the market had turned sharply towards VHS and in 1998, Sony began marketing their own VHS machines, all but abandoning BetaMax.

With Sony’s technology advantage, how then did VHS manage to defeat Beta? The answer will continue to be debated, but there appear to be three primary reasons: 1) unsuccessful, but disruptive, legal actions by Universal and Disney Studios in the late 1970's which named only Sony, 2) the lower costs of VHS in the late 70’s, and 3) perhaps the biggest factor, failure by Sony to appreciate the advantage in consumers’ minds of extended taping time versus recording quality and reduced tape size.

Sony misunderstood the technological attributes most important to VCR customers: length of record time versus video quality and tape cassette size, a critical mistake. Unfortunately, mistakes such as these remain common.

This case exemplifies the fate of thousands of similar cases of technologically superior products failing to become a success. They allow us to make the following observations:

1) Superior technologies don’t always prevail in the marketplace.

2) Companies often don’t know their customers as well as they think they do.

We believe these two observations account for many of the difficulties in applying TRIZ to consumer product development.
2. Comparing TRIZ and HCD

2.1 What is Human-Centered Design?

A modern approach to HCD described by Patnaik and Becker (2001) requires that stakeholders be studied at a very deep level. We aim to understand their particular activities, beliefs, preferences, emotions, motivations, troubles, and environments. We want to see users’ messy realities; to understand their mistakes, short-cuts, and work-arounds; and to learn about the personal significance and meaning they attach to their activities and product interactions. When one has a complete picture of consumers, then the most important set of unmet needs, appropriate to both the user and the organization’s business strategy, can be identified and addressed. Once concept solutions have been generated, the rich understanding of a consumer group can be used to evaluate those solutions by criteria most important to consumers, the very people paying for the product.

2.2 HCD Methodology

The primary research method of HCD is Ethnography. Ethnography is an anthropological technique in which people are studied in their natural context. It can mean observing consumers doing what they normally do, as if a fly on the wall; talking to consumers about their activities as they do them; or it can mean becoming an active participant in the same activities as the consumers. In all cases, the point is to learn what consumers do in their natural context, what matters to them, and why – to see the world through their eyes by building empathy (Leonard and Rayport, 1997).

Contextual research is necessary because various studies have shown that consumers are unknowingly prone to influence from outside factors that can be difficult to identify in a focus group or survey. In one experiment performed by Cheskin Research (Gladwell, 2005), a beverage was placed into two different bottles, one bottle looking rather plain, the other quite fancy. Taste testers reported the contents of the nicer looking bottle as tasting better, despite the fact that the two bottles contained the same liquid.

Moreover, what users say that they do, and what they actually do, can vary significantly, especially when they are removed from the relevant context. People have a hard time reflecting on, even noticing, the ordinary and habitual activities of every day life. They report with conviction on what they believe to be true, not necessarily on what is true. They alter responses to sound more competent to or agreeable with interviewers. Superficial research techniques are simply insufficient to uncover deeper customer needs.

While much of this research is done prior to development, HCD also requires ongoing learning from stakeholders through the use of frequent prototypes.

2.3 TRIZ and HCD Side-by-Side

Whereas problem abstraction is central to TRIZ, HCD takes the specific user and context as its main tenets. The HCD practitioner views needs, arising from subtleties and contradictions in human behaviour, as the focal point for development. The TRIZ practitioner places physical and technical contradictions and potential at the forefront.

Both methodologies adhere to similar development frameworks, in which research and analysis phases are followed by solution generation then evaluation phases. Mann (2002) breaks the systematic innovation process into four steps, which repeat iteratively: Define, Select Tool, Generate Solutions, Evaluate. Within problem definition, HCD emphasizes problem finding. While an array of TRIZ tools support the problem definition phase, in our experience, TRIZ practitioners often define the problem space based on insufficient
information drawn from management imperatives, marketing perspectives, or their own experience, instead of user research. Doing so places the product’s future success at risk.

TRIZ is a highly structured approach to innovation, while HCD follows a less structured approach and, in particular, provides very little structure for generating solutions. Too often, HCD practitioners leave the technological innovation to traditional brainstorms and the experience of the design team. As a result, the “what” and “how” of concept development can suffer. In contrast, TRIZ’s structured approach and leveraging of other successes results in a more robust exploration of the solution space.

TRIZ’s development from a historical analysis of design solutions also provides it with strong technology forecasting. While HCD provides no formal means of technology forecasting, an in-depth understanding of consumer needs allows one to evaluate which types of products are more likely to succeed in the marketplace.

A summary of several key differences between TRIZ and HCD are shown in Table 1.

Table 1: Comparison table of key differences between TRIZ and Human-Centered Design

<table>
<thead>
<tr>
<th>TRIZ</th>
<th>Human-Centered Design</th>
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</thead>
<tbody>
<tr>
<td>Focus on functionality and technical side</td>
<td>Focus on human needs</td>
</tr>
<tr>
<td>Leverages prior technical successes</td>
<td>Leverages anthropological techniques</td>
</tr>
<tr>
<td>Emphasizes abstraction</td>
<td>Emphasizes context</td>
</tr>
<tr>
<td>Highly structured approach</td>
<td>Loosely structured approach</td>
</tr>
<tr>
<td>Prescribes what and how</td>
<td>Describes why</td>
</tr>
</tbody>
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3. Integrating TRIZ and HCD

Having described the relative strengths of the two methodologies, we now present the framework of Use, Usability and Meaning (Barry and Patnaik, 2000, adapted from Sanders, 1992) as a means of deciding when each is most appropriate.

3.1 The Use, Usability, Meaning Framework

‘Use’ refers to what users can do with a product and the main functional benefits it provides. In this sense, it is synonymous with the TRIZ notion of function. ‘Usability’ refers to the ways and ease with which users interact with a product. It is more than just how easy a product is to use, but also the senses that are engaged, the contexts in which engagement occurs, and the affordances the product provides.

‘Meaning’ is the most esoteric of the three. A consumer product is more than the sum of the functions it performs; in addition to buying the functionality of a product, users are purchasing a system of meanings either intentionally embedded in the product, or associated by the individual through happenstance. Meaning is created through a product’s context of use and usability, as well as through advertising and branding. But for a product to hold meaning requires that the user create internal associations between the product and personal experiences or widely-held cultural beliefs.

The relative importance of each of Use, Usability, and Meaning depends on the product application and the context of its use. The internal workings of a lawnmower engine probably carry little Meaning for users, who simply care that it turns the blades fast enough to cut grass. The sounds that a Harley-Davidson motorcycle engine makes, however, carry much Meaning to its users. Indeed the appearance and sound of Harley-Davidson engines
contribute towards a feeling of adventure, power, and one-ness with the road that create customer loyalty matched by few other products.

HCD practitioners look for unmet needs within each of Use, Usability, and Meaning, but also for gaps between the three: For example, does the Usability reinforce the Meaning? Does the Meaning create Use problems?

3.2 When TRIZ and HCD Apply

We propose that the importance of studying consumers for the development of a product depends on the amount and type of interaction between the consumer and the technology. The more direct interaction a customer will have with the product, the stronger the need for HCD approaches to understanding and soliciting frequent feedback from customers.

Products can be classified according to the relative importance of Use, Usability, and Meaning to the product’s adoption. Products in which Use is the primary driver, and Meaning and Usability are of little importance, are “under the hood” technologies, characterized by little direct user interaction. This is the case with technical problems such as inside an engine, or the mechanics of a refrigerator. These problem-solution spaces can effectively be explored using a minimal amount of user research and thus can rely heavily, if not exclusively, on TRIZ methodologies.

Usability issues require studying users to determine where and when users encounter problems, what their workarounds are, and the precise differences between their expectations and what they encountered. But TRIZ also contributes here, particularly if usability issues are physical, as in ergonomics, where, for example, the Trends of Technological Evolution are effective for pointing designers towards improved solutions. When correctly identified, TRIZ is also powerful at solving usability trade-offs such as the Flexibility-Usability trade-off seen in many remote controls: as the flexibility of the controller increases, the increased number of buttons needed makes it more complex to use (Lidwell et al., 2005).

Products that require conscious adoption and interaction by users, such as cell phones or clothing, often must fit within a system of user meanings and require a greater emphasis on HCD methods than TRIZ methods. A thorough understanding of consumer attitudes, beliefs, values, and expectations is important, as is an understanding of how changes to Use and Usability will affect these. The three realms are closely intertwined, each impacting the others. Handing an innovative technical solution to marketing to “attach meaning to it” will rarely produce truly successful products. Even products that appear primarily Use focused, such as a hammer, can benefit from HCD techniques; where Meaning does not already exist, there is the opportunity to create it and enhance customer loyalty.

This is not to say that TRIZ cannot be usefully applied to issues related to Meaning. Indeed, for each of the three dimensions of Use, Usability, and Meaning, TRIZ is useful in providing structure to clarify relationships and end goals. The five pillars of TRIZ – Ideality, Functionality/Attributes, Space/Time Interface, Resources, and Contradiction elimination –
are all, at least philosophically, useful concepts to approach each dimension with and would benefit from further research.

During problem definition, for example, one might consider the following useful questions regarding Ideality: Based on customer research, what are the ideal final results for each Use, Usability, and, Meaning issue? Can we meet a need without any cost or harm? What’s stopping us from achieving the ideal result and why?

Functional and Attribute Analysis (FAA) can also apply to non-technical problems (such as in Mann, 2004) to better understand the relationships between components of the issue, whether they be physical and related to Use, behavioural and related to Usability, or psychological and related to Meaning. Visually mapping those relationships allows the designer to see the whole picture and is a powerful means of making sense of information.

The TRIZ philosophy of no compromise contradiction elimination is also very powerful for resolving situations where users have conflicting needs, whether they relate to Use, Usability, or Meaning. For example, one’s need for adrenaline rushes, but also safety.

4. Conclusion

We recommend that care be taken when using TRIZ methods alone for consumer product development, as TRIZ does not provide tools to understand and learn from consumers, who may have complicated, beneath the surface needs beyond that of simple functionality, particularly with regard to systems of meanings. We believe TRIZ and HCD methods complement each other well and have suggested a means of evaluating the appropriateness of each through the framework of Use, Usability, and Meaning, but believe there is still much opportunity for research in adapting the specific tools and processes of each for the other.

5. References

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