# User-Centered Generation of New Product Concepts: A Case Study Of Human Factors and Industrial Design Collaboration

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This paper describes a non-traditional user-centered approach for developing the first concepts for a consumer product having a new technology not yet seen in the marketplace at the time of the study. The method facilitates significant user contributions to the generation of compelling concepts by engaging them in both graphically and physically visualizing and communicating their perceptions. A Human Factors Engineer and an Industrial Designer collaborated to apply the method for the purpose of ultimately developing usability and appearance models for the new product. Interviewing and real-time sketching were used to translate users' ideas to graphical form. In addition, the children's game, Mr. Potato Head, was adapted to allow users to physically build concepts. Twelve participants were engaged in the study and the result was a diverse set of candidate concepts for the product. Although the study met our objectives, learnings are discussed that could enhance future deployment of the method.

## BACKGROUND

User-centered design has become a popular term for involving users in the design process. However, it means different things to different people. It can mean performing a task analysis of a user at work, creating day-in-the-life scenarios for using a new product, conducting a user evaluation of a product concept, or user testing a working prototype. Ideally, it means all of these and more as the user is involved from cradle to grave, i.e., throughout the development process. However, customers or users are typically involved by having them evaluate concepts already defined by the product development team.

One of the most challenging tasks in employing user-centered design is how to meaningfully involve users at the earliest stages of product development. Brainstorming, ideation sessions, and focus groups are often successful techniques of choice to identify user needs or problems and to elicit ideas for addressing them. However, they are totally cerebral exercises and don't necessarily reveal latent needs that defy articulation.

We decided to try a unique cerebral procedure combined with a hands-on method to develop user-centered concepts for a consumer product. The hands-on method is based on the children's game called Mr. Potato Head. The game comes with a potato-shaped head and many different-looking noses, mouths, eyes, etc. The child can make a large variety of faces by placing different combinations of face parts on the head. In the product design realm, the idea of the game has been used at the University of Michigan Transportation Research Institute to define preferred dashboard and interior controls and displays on cars. (Green, 1989) Subjects, seated in the front seat of a "test" car, were given several alternative control types for each dashboard function. They were asked to select their preferred control and place it at the desired location on the car's interior including its dashboard, shift stick, and door.

## STUDY OBJECTIVE

Our study focused on the design of a digital camcorder that recorded onto DVDs, a new technology at the time. The ultimate objective was to create a design that was superior to existing camcorder products in terms of appearance and usability. The design would have to be compelling to both current owners and non-owners of camcorders. The first phase of the effort to achieve the goal consisted of identifying user-centered designs that could be made into working camcorder prototypes. We started by defining a broad range of novel concepts for the camcorder design and configuration. About a dozen divergent designs were selected from these ideas for which appearance models were built. In a second phase, we then took these models out to focus groups to find out which ones were compelling enough to warrant building working prototypes. In the focus groups we used a quantitative approach to successfully evaluate and differentiate the concepts. That phase of the study will be reported in a future publication.

To get a divergent set of novel concepts, we employed three different sources. Two of the sources were Industrial Design (ID) firms who were selected from twenty-one proposals received from ID firms that responded to our request for proposal (RFP). Their capabilities, experience and proposed user-centered approach to developing the camcorder concepts met our selection criteria. The third source was a collaborative effort of internal corporate Human Factors (HF) resources and an affiliated outside ID firm.

This paper describes the collaborative HF and ID approach we used to develop user-centered designs for a new type of camcorder. Detailed findings regarding users' preferences and rationale for their input are not covered here. The main purpose of this paper is to offer unconventional concepting methods that practitioners can adopt and adapt for their own studies.

## METHODOLOGY

The challenge in this study was getting participants to think beyond their experience to a future time when they would be using a disk-based camcorder. We attacked the challenge by having participants convey their concepts both graphically and physically.

Twelve participants – 9 male and 3 female – were recruited from within the company. A request for volunteers was broadcast via an electronic notice to several large departments. Respondents were screened to ensure they were not working on a related project. Selection requirements included camcorder ownership and reasonably frequent usage.

The study was conducted in a usability lab containing a living room setting with a TV/VCR and sitting area. The lab was separated from a control/observation room by a one-way window. Video cameras in the lab were used to tape the sessions.

We constructed a session procedure that consisted of four phases – current experience, orientation, graphical visualization, and physical visualization. We intended to run the first two participants as pilots and then modify the procedure as necessary. However, the sessions with the intended pilot participants proceeded well and we made no substantial changes to the procedure. Results from the first two participants were retained and considered along with other participants' results.

*Phase 1: Current Experience:* The session started with participants identifying the type of camcorder they own and describing their usage behavior. The Human Factors interviewer asked general questions such as "How do you use your camcorder"? As necessary, he prompted them with follow-up questions until we knew what they took videos of, where they took them, and what they did with them afterwards. Discussion included camcorder features they utilized and preferred, dislikes about their camcorder, portability, quality of images, battery life,

duration of use, meaningfulness of videos taken, and methods used to alter viewing of the videos they had taken. Besides finding out the background they came to the session with, the purpose of this phase was to establish a rapport with the participants, to make them comfortable talking to us, and to get them thinking about taking videos.

*Phase 2: Orientation:* In this phase, we familiarized the participants with the new disk technology intended for use on the future camcorder. We compared disk and videotape technologies including accessibility, quality, and capacity. Videotapes of potential futuristic usage scenarios were shown to convey non-conventional paradigms for taking, transmitting, and sharing videos. The purpose of this phase was to prime participants for creative thinking required in the next phase.

*Phase 3: Graphical Visualization:* At this point, we asked participants to describe how they would use a disk camcorder and what it would look like. The Human Factors interviewer prompted them for specifics about its portability, what features it would have, how it would be held, how images would be viewed during capture and playback, etc. The prompting was done carefully so we did not pass ideas to them that they were not thinking about. During this time, the Industrial Design member of our team sat behind the one-way glass sketching the configurations being described by the participants. At the conclusion of the description, the Industrial Designer joined the participant and interviewer and showed the sketches. He then modified the sketches, as necessary, according to the participant's reaction. The participant either accepted the sketches as drawn, directed changes to the sketches so they corresponded with what he/she meant, or elaborated on their original thoughts and drove new sketches.

*Phase 4: Physical Visualization:* In this last phase, attention was focused on the Mr. Potato Head table. On it were the different "eyes", "ears", "noses", "mouths", etc of a camcorder. For instance, there were 5 lens volumes of different sizes, 5 battery volumes of different shapes, 2 different size disk drives and so on for all the necessary elements of a camcorder including viewfinders and LCD display screens. In addition, there were various cable types, power cords, headphones, clips, buttons, knobs and assorted other parts. We intended to avoid biasing the participant by having a large diversity of components they could choose from. A large number of Velcro strips were also available. The volume components were covered on all surfaces with a felt-like material that would accept Velcro. Other components had Velcro pieces already adhered to their flat surfaces.

The participant was told to build a camcorder that he/she would like to own. Before starting, instructions were given that the camcorder had to have a lens and a disk drive. Beyond that, they were allowed to choose what components they wanted and told to use the Velcro to hold the pieces together. Finally, we employed the traditional "think aloud" method, asking them to tell us what they were doing and why as they were constructing the camcorder. When time allowed, we asked the participant to build a second camcorder that would be used under different videoing conditions than the first one. For instance, if they intended the first one for indoors, we asked them to construct an outdoors camcorder.

## RESULTS

We undertook this approach to see if we could get a diversity of DVD camcorder concept ideas that could be made into appearance models. We also wanted to understand the thinking behind the various concepts because this was the user-centered information that would show how the concept related to intended usage of the camcorder.

The physical output of the sessions consisted of rough sketches from Phase 3,

photos of "as-built" concepts from Phase 4, refined detailed sketches made by the Industrial Designer of the "as built" concepts, and session videotapes from all phases. The concepts represented a diversity ranging from a fairly common "point and shoot" type camcorder to a wearable, hands-free configuration. In between were a variety; of hand held embodiments and some hands-free forms that could be placed on a table so the user could get into the video. A photo of the wearable configuration is shown in Figure 1. It is a distributed components concept with the lens mounted on the head, the LCD screen located on the wrist, and the disc drive attached at the waist. Communication between the components is via cable connection. Appearance models of this and selected other concepts were made from the refined sketches for presentation in the later focus group sessions.

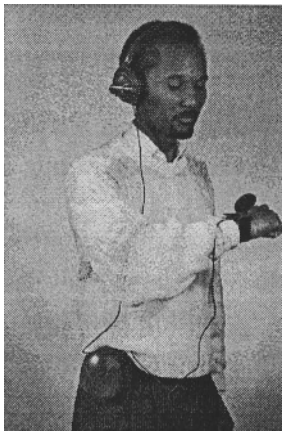

Figure 1: Wearable camcorder concept

## DISCUSSION

Because we were looking at a product technology that wasn't yet on the market, it was important to have a procedure that allowed participants to think beyond their current experience. While our methodology succeeded for our purposes at the time, it was our first time trying it and we identified important factors to consider the next time we wanted to use it. We also recognized procedural improvements and limitations that have to be considered in its application under different circumstances.

1. The Human Factors person and the Industrial Designer have to get their act together ahead of time. In particular, it is critical that the Industrial Designer informs the Human Factors person what kind of information will facilitate the sketching. This will help elicit useful information from the participant during Phase 3.

2. The success of the approach, especially in Phase 3, is highly dependent on the skill of the Industrial Designer. Working in real time to translate a verbal description into a viable sketch is challenging and may not be in the repertoire of some Designers.

3. The method is not very useful for eliciting details about user interaction. About the most that can be expected is the participant's definition for the controls they specify in Phases 3 and 4.

4. Much care must be taken in considering the parts that are laid out on the table for the participant to use in constructing the concept model in Phase 4. A sufficient diversity of parts must be available to give flight to their imagination, but too many could be overwhelming. Too few, of course, could bias the concept they build by restricting their choices. A necessity is a range of sizes and forms for the must-have components.

5. The overall session can get quite lengthy and the duration is variable, mainly because of Phase 4. Many participants were slow in starting to build their concept, but then got into it and speeded up. Sufficient time needs to be given to them for getting comfortable with the task.

6. The methodology seems to work for participants who are engineering design types. The jury is out on success with other

types of users and with non-users. It may turn out that participants need to be screened to find individuals that are "imaginative" and at the same time meet other usage specific criteria.

7. If a usability lab is not available, the Industrial Designer can do the Phase 3 sketching in full view of the participant. However, the potential for being a distraction or biasing the outcome is not yet known.

## CONCLUSION

Usability practitioners often are overlooked as contributors to early phases of innovation in companies. They tend to be called on to support ideas after concepts have been identified and some design details need to be worked out. In contrast, Industrial Designers tend to get involved earlier because they can help visualize new ideas. The methodology described here provides an opportunity for Human Factors and Industrial Design to team up to make early and meaningful contributions to a company's efforts to create innovative new product concepts.

When budgets and/or development time are too limited to allow ethnography studies, this methodology could be an adequate substitute for eliciting unarticulated user needs.

As inferred by the aforementioned considerations, the methodology must be applied with careful forethought. Of special concern are the uncertainties in items 6 and 7. If either of these situations is present, some exploratory research would be advisable to resolve those uncertainties.

This paper has been written with the hope that others will try the methodology, improve on it, and report the results to the product usability community.

## REFERENCES

Green, P., Paelke, G., and Clack, K. (1989). Instrument Panel Controls in Sedans: What Drivers Prefer and Why (*Technical Report UMTRI-89-15*). Ann Arbor, MI: The University of Michigan Transportation Research Institute, July.