INTRODUCING CO-DESIGN WITH CUSTOMERS IN 3D VIRTUAL SPACE

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ABSTRACT
Physical co-design methods help everyday people express their dreams of how products could be designed. They help researchers, designers, and potential end-users of products collaborate and generate innovative ideas during the research and design process. Are there ways to use virtual 3D computer technology to facilitate co-design in virtual space? What tools are available? This paper explores these questions and describes how 3D digital technology is being used to promote people-centered design.
Virtual 3D co-design methods are an outgrowth of physical co-design methods such as 2D collages and 3D Velcro modeling, developed by Dr. Elizabeth Sanders and others featured in The International Journal of Co-Creation in Design and the Arts. These physical methods have been widely accepted as effective ways to involve people outside the design team in the research and design process. Virtual methods offer promise to those seeking to make the principles of co-design available to larger groups of people in discrete locations around the world at lower cost. Additionally virtual 3D co-design methods facilitate insights in ways that are different from physical methods.
This paper places this subject in the historical context of user-centered design research for product design, describes current practice of physical and virtual co-design methods, and presents two case studies of how this methodology can be used. Findings also reveal that virtual 3D co-design methods have certain advantages and drawbacks compared with physical methods, and that high technological savvy is not needed by stakeholders using these methods.

Keywords: Design Research, User-Centered Design, Virtual Product Development, Co-Design

1 INTRODUCTION

Most industrial designers have heard about or practiced some kind of design research as they work through the design process. This can include: Intuitive Design, where our own experience or otherwise putting ourselves in the customer’s place can serve us as we act as the customer advocate; Informed Design, where we receive information from research (or researchers) from outside the design team; Ethnographic Design, where we study everyday people as they become subjects of design research; and Participatory Design, where we include everyday people in the design process through methods used to help them express their hopes, dreams, and creativity.
All of these approaches can serve, either directly or indirectly, to involve everyday people in the design process. They can also be used in combination as the situation

dictates. Each approach is part of the greater whole of people/human/user-centered design.

Participatory design, or Physical Co-Design, methods used in product design research are well documented ways of helping everyday people express their dreams of how products can be designed. Currently, these methods help researchers, designers, and potential end-users of products collaborate and generate innovative ideas during the research and design process using methods such as collage making, workbook/journaling, and Velcro modeling [1-3]. Participatory design can also extend into the more evaluative and refinement stages of product development. Everyday people can help evaluate concepts through methods used in human factors testing and offer feedback or respond to concepts and prototypes in order to validate or make corrections to design work. When a product hits the market, everyday people can participate in design by experiencing the product for next generation improvements.

Co-Design in Virtual Space (CoDeViS) offers another avenue for participatory design research and customer collaboration. It leverages the power of computer technology – not as a replacement for physical co-design methods, but as a supplement. CoDeViS is facilitated not only simply through email and web site interfaces that allow different people and groups to connect, but in virtual 3D space. This can be done at various stages of the design process (e.g. concept generation, refinement, and testing) and through various media/channels of collaboration (e.g. file transfer, intranet/network, internet/website). Additionally, students in design tend to be comfortable with this approach and the rising “millennial” generation will most likely be comfortable administering and participating in this method of design research.

Inviting customers into the design process can, of course, be problematic. Issues of time and cost burdens to product development cycles immediately come to mind. These issues may limit the involvement of everyday people in the design process, regardless of the potential for human-centered design and innovation. The usual time and cost requirements of participatory design can be significantly reduced using methods of CoDeViS because computer technology can be leveraged by increasing the numbers of people who may also be reached at lower logistical costs. For example, end-users could participate using their own home computer with an internet connection.

As with any approach to design research, there are certain drawbacks to using CoDeViS methods as well. Issues such as the separation between physical reality and virtual reality, scale, and tactile feedback are limited or impossible, but the use of CoDeViS can be seen as a natural “next step” in the evolution of design research tools. The ongoing search for more effective and efficient methods of design research for product designers has been an evolutionary struggle for much of the last century.

2 HISTORICAL EVOLUTION

Design research in industrial design has evolved over the past 50 years. This evolution has included a shift from an intuitive approach to design, to a more research based practice. Designers who conducted research remained a minority until an increase in methodological sophistication began to occur in the late 1970’s and 80’s when design firms began hiring social science research experts who shared their approach to research and helped formalize the design research process and methods. Industrial designers have, in a sense, “borrowed” traditional research methods used in the social sciences (e.g. observation and interviewing) and time compressed the typically long duration of an ethnographic field study to appropriately fit the demands of fast product

development; these methods are also used in a more targeted way that reveal unmet user needs.
The inclusion of social science expertise helped formalize research in industrial design and has given credibility and added value to the research activities of industrial designers. Research based industrial design has become standard practice with many industrial designers and in product development. Research in industrial design has been evolving and one option will be to use virtual space as a potential facilitator of more efficient qualitative and quantitative research and design [4,5].

3 THE CONCEPT

Relying on the creativity of end-users during the design process is well founded. This has been done for years using physical methods and tools. Design firms such as Fitch, Sonic Rim, and Make Tools (recently founded by Elizabeth B.-N Sanders) have or are including everyday people in the research and design process as co-designers. One concept that helps us understand the potential value and basis of CoDeViS during concept generation is to understand the idea the above firms promote as: “Make, Do, Say.” This represents a spectrum of end-user participation methods in research and design:

Table 1 Say Do Make

Say	e.g. Interview, Questionnaire, Discussion Group
Do	e.g. Observation, Usability Test, Video Ethnography
Make	e.g. Collage, Workbook, Velcro Modeling

Using this model, the design team can get a more complete understanding of the customer through what they talk about, how they actually act, and how they express their dreams through making things [1-3,5].
Velcro Modeling in particular enables a participant to create actual forms that are abstract yet have physical dimensions that are concrete without being heavy laden with specific sensory detail such as color, surface texture, exact dimensions, or other realistic representations that are more appropriately left to later in the design process when concepts or prototypes are being refined. The abstract and iconic nature of Velcro models allows enough room for the participant and others to envision the potential of the ideas that the participant/co-designer is trying to express [2,6].
Before Velcro Modeling occurs there are usually immersive activities and tools that the participant co-designers engage in before making models. This usually entails journaling or workbook activities that help the participant to immerse themselves in their existing experience so they are prepared to deal with and express problems they are having or ideas they want to share when they create representations. Following this pattern, CoDeVis can also help participants express their creativity and dreams with the added possible benefit of lower cost, time, and a greater number of participants. The following pilot studies serve to illustrate how this can work.

Eight graduate students were recruited to express their ideas about the future of car interior design for a single occupant commuting vehicle concept. Each of the participants was familiar with commuting to work and/or school as it typically occurs today in existing cars. Without any specific training or instruction they were directed to a web site where three files could be downloaded to their personal computer. The files were the following:

1. MS Word document that contained directions, a story, and a 2 part questionnaire
2. Google SketchUp application (a 3D modeling application available at no cost)
3. SketchUp 3D model file containing a one person commuting vehicle concept with abstract shapes to use as virtual “Velcro Modeling” parts (see figure 1 below).

As the participants worked with the CoDeVIS tool they were asked to complete three steps:

1. Record current experience and pay attention to various aspects of the commute such as: controlling, sitting, storing, securing, entertaining, communicating, eating, and drinking.
2. Read a scenario that describes the participant getting into the car and what the vehicle is capable of in terms of technology, speed, and safety. The scenario concludes by stating: “Your commuting experience is restful, productive, and safe. You arrive at work feeling good about how you just spent your time and pleased with how your day has begun.”
3. Familiarize with Google SketchUp and open the SketchUp 3D model file so that the interior can be designed by moving and placing abstract shapes that are assigned meaning and notated by the participant using a text tool. Figure 1 shows the SketchUp model as it was first opened (left). Figure 1 also shows a model file that has been manipulated and notated by one of the participants (right).

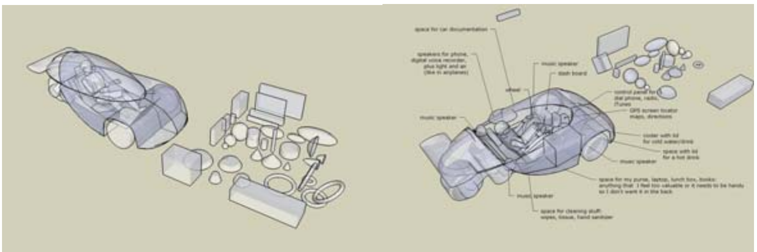

Figure 1 Commuter car CoDeViS

Finally, after using SketchUp, the participant was directed to record an ideal experience in the MS Word document. Again, they were asked to address issues they considered in Step #1 and any additional ideas that came to mind. The SketchUp and MS Word files were then saved and uploaded to the web site for analysis.

A content analysis of the files submitted by the participants revealed a variety ideas expressed and a broad range of features/capabilities that were designed into the car. A majority of participants, however, wanted to have some level of automation in the car enabled by imbedded computer technology and connected to the outside world through wireless technology; a kind of robotic car that allowed the passenger to focus attention on activities such as: work, relaxation, breakfast, entertainment and communication. After the participants completed their work, they were asked open ended questions such as likes, dislikes, and time to complete. A majority of the participants appreciated most aspects of the study but were somewhat irritated with learning how to use an otherwise "simple" 3D modeling tool. The participants used approximately one hour of their time to learn the basic functions required to complete the 3D work.

In an actual project using this method of CoDeViS, the ideas of the participants would be further analyzed for common traits, combined, or expanded into concepts with the aid of a designer or design team. Concepts could then be shared with the original participants or another group of participants for further evaluation and refinement.

5 CASE STUDY #2

Eighteen undergraduate students were asked to express their ideas about the future of car doors. Step 1 included asking participants to follow directions and answer the questions below.

- Begin by sitting in the driver's seat of a car and noticing any problems or opportunities for the redesign of the door. Think about the following questions:
- How does it feel or respond as you open and close it?
- How does it help or hinder you getting in and out?
- What doesn't work or could work better?
- What could the door do better for you while driving?
- How would a better door design look to you?

Step 2 included fantasizing and writing at least one paragraph, using MS Word, about changes they would make such as:

- How might a door redesign make you feel more comfortable?
- Are there any things you might take away, add, or modify?
- Where they would like some (or all) of the controls such as: seat controls, door handle, door lock, door open latch handle, speaker, air vent, window controls, other controls, and other features.

Figure 1 shows the SketchUp model as it was first opened (left). Figure 1 also shows a model file that has been manipulated and notated by one of the participants (right).

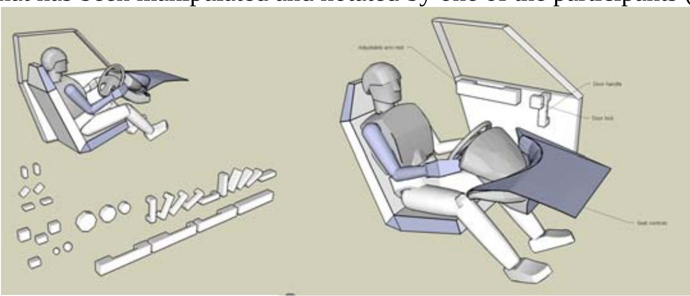

Figure 2 Car door CoDeViS

Again a variety of ideas and possible concepts were expressed. Better flexibility and customization options in arm and handle positioning were commonly desired.

6 CONCLUSION

The strengths of CoDeViS methods include reducing cost and time to gather the thoughts and creativity of large numbers of everyday people. There is also the potential, because of the digital nature of the data, that the participant responses could also be analyzed using fast and efficient computer analysis tools. These strengths could be compelling to the many companies that desire to conduct user-centered design research but struggle with the money and time investment required by traditional methods. Weaknesses of CoDeViS may include lack of direct physical interaction with full sized objects and actual face-to-face meetings with people in the design team. Interestingly, for everyday design team members, the case studies described above did not require a high degree of technical computing skill to conduct the study; this method is highly accessible and adaptable without the need to purchase specialized expertise, software, or equipment.

In principle, students should become familiar with the following: First, sensitize participants to a current experience and look for problems (e.g. “Please record in the spaces below what your commuting experience is like. Focus on preparing to enter the vehicle, riding/driving to work, and exiting/leaving the vehicle…). Second, present a future scenario (e.g. “Some years in the future, you are standing at your front door and are about to leave for work. You are the owner of a high efficiency, renewable energy powered vehicle…). Third, ask participants to fantasize using the tools you provide (e.g. “Fantasize and write at least one paragraph...”).

Considering today’s ubiquitous computing technology, CoDeViS methods are a natural growth area in design research. CoDeViS methods can contribute to user-centered innovative product design and deserves attention.

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