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TECHNOLOGICAL PARADOXES IN INDUSTRIAL DESIGN

C. Gajewski

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1. Case study: Product development model and improvement strategies

1.1 ViCCi 2 (Virtual Customer Care Interface v. 2) interactive kiosk enclosure

"Today the growing need for rapid concept development in industrial design makes the application of digital technology one of the most important implements in research and industry applications. Without digital tools, the process of design usually is less accurate, takes more time, and requires more human resources to complete the same task. " [Gajewski 2003]
Existing design processes and commonly used technology are often not sufficient to communicate all of the properties of an object (including scale, materials and colour) effectively to clients for human-scaled and oversized objects without creating expensive full scale prototypes. Combinations of samples (paint colours, material choices and finishes) do not present a clear enough picture of the results of the final project. This can be particularly problematic where the ability to prototype is limited. This is even more prevalent when objects are to be placed in an environment where the influence of the surrounding area can alter viewers' perception of an object. The relationship of form and space to scale, colour and textural association is extremely important and can be in some cases dismissed without appropriate description. Industrial designers are trained to understand form, colour and scale among many other design methodologies and their 'intuitive' and learned approach to these object traits work well in brain storming sessions. Wherein trained design professionals work together to create solutions and a flat piece of cardboard can be made into a 3-D form and simple drawn lines indicating major elements, like interactive surfaces, are adequate techniques to describe an object. This is not typically the case when communicating ideas to non-designers (clients) where verbal description or even pictorial representations may not be easily understood. In the words of famous Italian industrial designer Vico Magistretti (1920 - 2006):
"Design does not need drawing, but styling does. What I mean by this is that an object of design could be described (…) by spoken or written words, because what materializes through the process is a precise function, and, in particular, a special use of materials which, as a matter of principle, leaves all aesthetic questions out of consideration because the object is to achieve a precise practical aim. That does not of course mean that a precise image cannot be produced that will reflect and express 'aesthetic' qualities proper to the new methodology used in the conception of the objects.
Styling, on the other hand, has to be expressed by the most exact drawings, not because it disregards function but simply because it wraps that function in a cloak of essentially expressed qualities that are called 'style' and that are decisive in making the quality of the object recognizable." [Fiell 2000]
In the case of small product design, the client is intimately familiar with the scale of common objects: pens, cell phones and coffee machines for example, even when re-styled. With new products, having

no standard shape or scale associated with it, it becomes much more difficult to comprehend scale based on 2-D images or scale models. With smaller new products, like the first MP3 player, this problem could be overcome with the creation of 1:1 sketch models, presentation models, functional models and eventually prototypes, where rapid prototyping is a great tool for indicating the shape, size and fit of the object. With new inventions of a large-scale, however, one is restricted by the number and size of prototypes that one can create, which in turn widens the gap of scale and material comprehension for the client.

Using traditional and CAID (Computer Aided Industrial Design) design processes, methodologies and technologies to design an innovative, large-scale interactive kiosk enclosure, I have identified some major barriers in our approach to effectively communicate with our clients. These include a lack of direct access to the client or lack of face-to-face contact because of large physical distance and difficulty in communicating scale and its' relationship to materials and spaces using traditional modeling techniques. In light of these issues, I have formulated a proposal and new implementation tactic that will assist clients to make more informed decisions while streamlining the process for the designer.

Figure 1. ViCCi 1 (Virtual Customer Care Interface v. 1), Nov. 2005

As a case study for this process improvement strategy is a large-scale product that I designed in 2006, an enclosure for ViCCi 2 (Virtual Customer Care Interface version 2). At the projects' commencement, version 1 (figure 1.) had been installed and in use for approximately 4 months and was the first of its' kind; a shopping mall interactive way-finding system that used a virtual agent, complete with a human voice and realistic human figure to direct customers and answer their questions. This new kind of kiosk was required to showcase its' technological advancement in customer care, act as a visible landmark to passer-by's, and also appear friendly enough that people of any age, gender or ability would feel not only comfortable, but enticed to use it. The Industrial Design component of the project was constrained by both budget and its' ability to house various electronic devices that were identified in advance.

With the interface, graphics and original enclosure tested and proven in the previous version of the design, it was time to experiment with the shape of the new unit. The clients in this case wanted to create a kiosk that incorporated many of the same features as the original, but with additional screens and a more commanding presence. Whereas the original unit was installed in a smaller shopping center with only one floor, the second version was to be installed in a much grander environment – a two story shopping center with wide open spaces and visibility to the second floor from the first. The challenge was to create a distinctive new product that stood apart from the original ViCCi 1 design, while speaking the same visual language. It would also need to fit into, but not blend with the environment in large architectural spaces. As in the previous version, the enclosure design was created based on parameters that were provided by the client such as number and size of screens, other electronic and mechanical components, a barrier-free design, and accessories such as a telephone and printed brochure holder. These features and components had been tested, and were successful in the first units.

2. How technology can assist or discourage the design process

In many cases people find it easier to write an email than to talk on the phone. Likewise, in business, sometimes it seems easier to discuss ideas or projects over the internet rather than trying to get numerous people together for a face-to-face meeting. In some cases, sending presentation drawings over the internet is a wonderful solution but it can also create undesirable outcomes.

Face to face contact between a client and a designer can save days, sometimes weeks of work from any project. Good communication is an essential part of the design process as it allows for both sides to voice their opinions and concerns about the direction of the project, and to come up with solutions, together. This in many cases is difficult when more than two people have to attend a meeting and in particular when we are talking about national or international collaborative work. The body language of all involved in a conversation is sometimes more telling than the verbal descriptors, the loss of emotion and personality being one of the biggest problems associated with communication by e-mail alone.

Understanding by all parties what is in front of them is essential. Drawings are typically the first wave of communication and in many cases give a general idea about the product, particularly about the shape of the design. In the initial stages, this low-tech approach can be invaluable to the design process, allowing the designer to come up with various forms and shapes and for the client to react to these forms, expressing also their preferences, likes and dislikes. Diagrams describing methodologies or timelines are also a helpful tool and are widely understood, giving the client a clear idea of proposed time restrictions and requirements associated with the project. This again gives them some power to make suggestions or changes in the initial stages of a project. Material samples can also give some idea about the finishes that designer or client envisioned for their product, however as these samples are out of context, it's left to the imagination of both parties to visualize how an object will look and feel with the application of these finishes. In today's world, all of these processes are most efficiently employed and most rewarding to all parties when used in face-to-face contact with the client.

Computer photorealistic renderings are extremely helpful, especially when one is dealing with commonly used materials. If the client has previous experience with that material it makes it easier for them visualize the material in a new context. This is often accomplished by presenting them with a sample of the material and desired colour, in combination with a photorealistic rendering of the product showing an approximation of that texture and colour on the rendered object. This process of material and colour choice is complicated further when the designer proposes a material that is unfamiliar to the client. Even with the aid of physical samples and photorealistic renders, it can be very difficult for some people to visualize 3-D objects in their minds' eye. In this instance, the decision making process becomes more difficult and the clients' more likely to react to this unknown factor in a negative way. The designers' approach can even come into question and the client may suggest or demand a "more conventional" alternative.

Inclusion of technology in presentation indicates to clients that changes to a digitally constructed design should be seamless and simple to do. Whether presenting drawings or renderings printed on paper, or a 3-D wireframe model in computer space, the assumption is that anything done on a computer is infinitely and easily revisable. In some cases, this assumption is true. When presenting a 3-D wireframe for example, colours and textures of the object are relatively easy to manipulate. As is the case with scale – but only in the initial stages of the design, and as long as the client is aware of the limitation of the components and necessary tolerances required inside the object. Apart from these two instances, changes can be difficult, time consuming and very costly to the client, especially in the later stages of the design. Reducing the height of the object by two inches or adding a button or a larger screen might make a re-design of the entire object necessary.

3. Understanding scale and form of the object

In the case of ViCCi 2, problems arose when the time came to identify the precise size of the object. As we all know, the visual reference of the scale of any physical object can be affected by multiple factors ranging from the colour of the object, (where light colours tend to make object appear larger and dark colours visually make objects appear smaller), the size of the room, (if the room is too small it will feel cramped and if it is too large it will disappear) and the placement of the object within a space (if placed close to the wall it becomes integrated into the environment however, when it stands in the middle of the room it commands a certain importance).

In the context of this case study, the object was being designed for a specific client to be displayed in a specific space, a shopping mall. Following my standard design process, I first used sketches and later renderings to indicate the scale and shape of the object to the client. In the original design brief, this product was supposed to be of a larger scale than the original ViCCi 1 unit, and was supposed to incorporate five screens into the design. Having presented the client with various concepts for the design, one was chosen, and I went ahead and made some simple orthographic drawings. In order to clearly indicate the scale of the proposed design, I made sure that the clients had an opportunity to view the original (and smaller) three screen ViCCi 1, in person and on-site in a local shopping mall. In conjunction with this, the orthographic drawings were presented alongside two 3-D printed 1:10 scale models; one of ViCCi 1, and one of the proposed five screen ViCCi 2, to enforce the differences in height and width between the two objects.

Following this presentation, the client requested that the object be visually 'slimmed down' and requested a full scale model be created and transported on-site to the shopping center that it was being designed for. All other aspects of the design were approved at this stage. A 1:1 scale, slimmed down, white foam-core model was created (figure 2.) and transported to the shopping center. Viewing it in the mall, the client responded "Wow, that's so big!". After spending some time examining the unit, however, the client became more comfortable with the size, but their initial reaction persisted. The limited budget for model-making necessitated a light and relatively simple solution, but creating a white model is not ideal, as the suggestion of colour and texture is not evident. In this case, the bright-whiteness of the object might have lead to the perception that the unit was physically overwhelming.

Technical issues and persistent concern over the size of the object prompted the client to reduce the number of screens to three for the new unit. Though theses screens were larger than the ones on the original unit, the size of ViCCi 2 could now be slightly reduced. These changes however prompted a thorough re-working of the entire enclosure (figure 3.).

Though many different approaches, from the very basic to the relatively hi-tech were used throughout the design process, issues regarding the scale of the kiosk and its' relationship to materials and environment persevered resulting in a much longer design phase. These challenges lead me to question the design process. Why, with so much knowledge, so many ways to talk about and visually represent an object did the full scale objects' 3-D form seem to remain a mystery to the client? And how could I have streamlined the process for all of the stakeholders, providing them with a clearer understanding of the proposed concept?

Figure 2. ViCCi 2, foam core model in-situ, June 2006

Figure 3. ViCCi 2, Jan. 2007

4. Human Computer Interaction: Interpretation of 3D form using the VR environment - proposed solution

The design process relies very heavily on the interaction between designer and client. In order to accommodate the clients' needs and desires, it is important to communicate as clearly as one can and leave as little to imagination as possible especially towards the final parts of the design. If the chain of communication fails towards the latter part of the project it becomes time consuming and expensive to get back on the right track. Although technology had been identified as a potential problem in the design process; conventional, physical modeling techniques were found to be expensive, time consuming and inadequate communicators. As CAID is common practice in industrial design today, it would seem advantageous to readdress the identified technological drawbacks of the previous approach and potentially incorporate a new, more sophisticated VR cave technology into the equation.

"The sketch pad, air brush and clay model all moved another step toward the history books (…) when Daimler-Chrysler (DC) opened a new Virtual Reality Center at its Mercedes-Benz passenger car development center in Sindelfingen, Germany. After only a few months of operation, this supercomputer-driven visualization facility proved so useful that the members of DC'S executive strategy board now approve designs using virtual images instead of physical properties. (…) But when a technician manipulates his roller-ball mouse to stop the car and rotate it for static analysis, changing the incident light, the color of the paint and other variables, it becomes clear that we've been watching a "virtual" C320. The metal, rubber and fabric don't exist in the physical sense. This is a two megabyte presentation file that can be displayed and manipulated a million ways on the $100,000 23-by-8-foot screen." [Sherman, 2001]

The utilization of VR technology by means of large scale interactive displays make it possible to minimize potential problems associated with traditional prototyping of large objects. For example, physical models can be costly to make, awkward and costly to ship, may suffer damage during shipping and may need to be stored for long periods of time. Ideally, with VR prototypes, designers will be faced with additional benefits over physical prototyping which will include the ability to scale the object in real-time, to test out materials and finishes in virtual space before a physical product is created and the ability to view the object at 1:1 scale in its' future physical environment or to test the object out in many different types of environments at will.

This technology has been utilized as a prototyping tool for object simulation in large manufacturing and design firms' research and development laboratories, as well as an expressive tool for artists where "the potential for immersive systems to create experiences far beyond those of, say, an ordinary sculpture are well recognized by art designers (e.g., Shaw, 2000) but are seldom realized due to the cost of such systems. It is expected that more interactive art will be constructed in the future, perhaps for perusal over the Internet or available in art galleries, with maybe even the ability to share the experience with people at other locations around the world." [Davies 2002].

Since visualization technology is in many cases driven by the entertainment (especially video game) industry, visualization tools become more and more powerful and less expensive on a daily basis. This eventually brings powerful technology into the hands of the desktop computer user and permits VR technologies to be more widely used, thereby allowing designers to tap in to the pipeline of technological pop culture and information flow. This demystification of technology allows the user to feel as comfortable interacting with, at this point futuristic equipment, as they would experience using a mouse to browse the internet, check their email, or play a video game. Computer and game users are becoming connoisseurs of more and more sophisticated graphics and have therefore become ever-more demanding. Today's bitmapped photorealistic game environments and sophisticated sceneries come with greater expectations from future interactive environments. This sophistication will eventually have to be matched by the VR cave environments for users to draw realistic parallels between the virtual and real world.

Thus far, VR prototyping use has been limited to large companies with both monetary and personnel resources needed to run such complicated and technologically advanced equipment. My aim is to use more common, scaled-down, less expensive emerging technologies and put them in the hands of individuals. In current VR cave situations, set-up and maintenance is performed by highly educated technical assistants. In the future this could be performed by a non-expert user through a simplification of the equipment and the interface required to use it. This technology will also facilitate meetings and presentations over large distances by allowing the designer to run the equipment remotely. VE will become an invaluable industry tool for the future small business.

Current VR cave systems allow for only simple image manipulation and have limitations when it comes to quick adjustments (of colour, texture and scale) when objects are set in a simulated environment. If these types of adjustments were possible on the fly it would allow designers to create and modify objects in real time in front of their clients. Currently, these types of alterations are most commonly done as a separate process which takes time and in many cases requires a second, third or fourth visit with the client, breaking work flow and prolonging the decision making process. Goals could be achieved more quickly if there was the possibility for infinite visual parameter manipulation in real-time. This then is not only a very powerful presentation tool, where multiple objects could be presented at different scales in a particular space, allowing the client to choose the object that they feel will best suit their needs, but also a powerful interactive design tool wherein real-time decisions could be made and applied through the work flow, streamlining the process for all parties.

"One of the main problems is finding a tool that can be used by non-experts without hours of training. Previously, non-computerized design tools have been employed, such as full-scale modeling, advanced meeting techniques, and role-play to activate end users' tacit knowledge and as a communication medium (EHN et al., 1996). These allow direct participation in the design process and are hands-on. However, the full-scale laboratory imposes to following limitations: difficulty in changing colour and lighting; ease of alteration (considerable physical effort is required to dismantle and rebuild rooms and to model an object); difficulty in documenting and reproducing visualizations; building very large environments; portability; and showing results after the laboratory has been emptied again. Additionally, all participants must come together in the same time and place-not always possible for a company or process industry (Davies, 2000). This is where a VE solution can be of help, with its user-friendly interface devices and time and space independence. The important considerations are how people will use the environment and the actions they will have to perform." [Davies 2002]

Creating designs in virtual space using CAID systems obviously has a lot of advantages; however designers face some obvious disadvantages identifying scale and proportion. This in not dissimilar to the problem faced by printing images using digital tools where computer screens utilize RGB light colour mixing technology and printers use CMYK pigment colour mixing technique. Likewise, a system of calibration needs to be created for virtual objects to be accurately represented in physical space.

My limited initial observation in the VR cave environment allowed me to understand some of the possibilities with the available tools and brought forward problems with the equipment and the detail (resolution) of the display. While I propose to use this technology to aid with question of scale, scale itself is a complicated issue. It is possible to overwhelm the viewer with objects in immersive environments and without scale indicators it is impossible to understand and relate to the size of objects on a 1:1 scale. As a new user and active participant within the environment it quickly became evident that it was important for me to look into understanding how the technology works and to what level of interaction I can bring my virtual models. The initial stages of testing, utilizing tools at the *Advanced Man Machine Interface Laboratory (*AMMI) at the University of Alberta, Canada, were based on simple interpretation of VR models and methodologies associated with simplification of file conversions and issues relating to discrepancies in scale found in 3-D CAID software and software used in the VR cave. Preliminary research indicates that while it is possible to create realistic, fully immersive environments and to associate physical scale to virtual objects within that environment one has to develop virtual architectural clues that the object can relate to. Otherwise, object scale could be misconstrued and the tests inconclusive.

5. Summary

Good communication is the most important ingredient to good design process. Without it, well designed products that fulfill all of the clients' needs are not possible. For designers, process improvements are inevitable and on-going as this field is also constantly evolving. While in the past, various tools and processes have been used, and have often been proven successful, they have also been proven inadequate to reach certain goals, such as communicating large 3-D concepts, textures, colours, scale of large products and the relationship between these factors to the surrounding environment. It is through experimentation that one can improve on existing methodologies and through questioning the status quo that we can increase our understanding of technology and its application in our lives.

Through the implementation of various techniques, I realized their drawnbacks as well as their strengths, and will continue this investigation through the application of various CAID/VR tools. Opening up new possibilities for these types of tools to be accessible to a wide range of users, through the use of common technologies and the development of user-friendly interfaces and processes.

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Cezary Gajewski, MFA, MDes
Assistent Professor
University of Alberta, Department of Art & Design
3-98 Fine Arts Building
Edmonton, Alberta, T6G 2C9, Canada
Tel.: 780-492-6368
Email: gajewski@ualbera.ca