# The Explanation for Design Ex-plan-ations

*Eli Blevis and Martin A. Siegel*

Human-Computer Interaction Design Program
School of Informatics
Indiana University at Bloomington
{eblevis,msiegel}@indiana.edu

## Abstract

We describe a notion of designs as "ex-plan-ations," specifically plans or explanations about why some things—artifacts, features of artifacts, interactions between people and artifacts, or interactions between whole ecologies of people and artifacts, futures and collective futures—are a certain way or why they should be another way. We describe how we have operationalized the notion of design as explanations in terms of a particular framework that we call the PRInCiPleS framework. Finally, we explain how the notion of design explanations and the PRInCiPleS framework is tightly integrated into our structuring of a curriculum in HCI and design (HCI/d) at the School of Informatics, Indiana University at Bloomington.

## 1 Introduction

In a workshop paper at CHI 2004, we defined a notion of design explanations, as a complement—perhaps a counterpoint—to notions of design targeted at the discovery of a generally optimal, universal process (Blevis, 2004). In our view, designs are ex-plan-ations, that is to say they are plans or explanations about why some things—artifacts, features of artifacts, interactions between people and artifacts, or interactions between whole ecologies of people and artifacts, futures and collective futures—are a certain way or why they should be another way. This definition is not dissimilar to Simon's: *"everyone designs who devises courses of action aimed at changing existing situations into preferred ones"* (Simon, 1996, p. 111).

In the context of HCI, we conceive of a design explanation as not only an account of how an interactive system has been or may be engineered in terms of its features and use-cases, nor is it only an account of requirements analysis in terms of user needs; a design explanation also includes an account of who the design affects; the value system under which the design is constructed; the possible strategies of implementation—from both a technology and enterprise perspective; the design's social value; the design's side-effects; and possible alternatives to the design.

This notion of design as explanation rather than process is not without precedence. Within the HCI literature, the notion is closely related to the treatment in Moran and Carroll's edited volume on the design rationale (Moran & Carroll, 1996). Our treatment emphasizes less the formalism, and more the construction of a community of practice and learning around the notion of design as explanation, as reported in (Blevis, Rogers, Siegel, Hazlewood, & Stephano, 2004). Our characterization of design in these terms is equally as well inspired by a diverse, primarily design-oriented literature that includes (Alexander, Ishikawa, & Silverstein, 1977), (Cross, 2001), (Fallman, 2003), (Fry, 1999), (Hubka & Eder, 1996), (Margolin & Margolin, 2003), (Moran & Carroll, 1996), (Schön, 1983), (Winograd & Flores,1986) and many others. An enumerative view of notions of design is described in (Atwood, McCain, & Williams, 2002).

In order to operationalize our notion of design as explanations, we have constructed a framework we call the PRInCiPleS framework as a mechanism for structuring design explanations. The framework includes six types of constituent notions for design explanations, namely predispositions, research, insights, concepts, prototypes, and strategies. The types and their ordering are represented by the acronym PRICPS, easily remembered as PRInCiPleS with the embedded word "nile" removed. In (Notess & Blevis, 2004), we have compared the PRInCiPleS framework to a more "standard" design method in HCI, namely Contextual Design (Beyer & Holtzblatt, 1998). One of the most important points about the PRInCiPleS framework is that it is only a framework, no more and no less. It provides a mechanism for structuring design knowledge as an explanation. It is not a process. It does not guarantee that a design explanation expressed in its terms will be sound in the rational terms of the design rationale after (Moran &

TITLE:
**Distributed Learning**
*[meta-data: distributed services, democracy, equality]*
…
PREDISPOSITIONS (VIEWPOINT):
P1: Everyone is entitled to an education
*[meta-data: democracy, parity of participation, education, equality]*
P2: There aren't always enough resources to go around
*[meta-data: zero-sum, scarcity of resources]*
…
RESEARCH-OBSERVATIONS:
P1,P2 ⇨O1: Some of the townspeople in college towns have never been on the campus; Universities are sequestered from the general public
*[meta-data: sequestering, privilege]*
P1,P2 ⇨O2: Not everyone can afford to attend the best colleges or universities
*[meta-data: sequestering, privilege]*
P1,P2 ⇨O3: Internet technologies enable wider distribution of quality materials in the same manner that the introduction of recording technology enabled people to listen to the best performers
*[meta-data: technology enablers, networking]*
…
INSIGHTS:
O1⇨I1: To make education accessible to everyone, it's a good idea to move the physical campus into the community with less intimidating artifice
*[meta-data: belonging, equal distribution of resources, community services]*
O2,O3⇨I2: To make education accessible to everyone, it's a good idea to distribute it more widely
*[meta-data: equal distribution of resources, distributed delivery of services, remote delivery of services]*
…
CONCEPTS:
I1⇨C1: Shopfront schools (after Christopher Alexander)
*[meta-data: highly-distributed services, retail model]*
I2⇨C2: Distance education
*[meta-data: networked services]*
…
PROTOTYPES:
C1⇨Pr1: Study Sylvan Learning Systems
*[meta-data: actual example of the concept]*
C2⇨Pr2: Study Existing Distance Education efforts
*[meta-data: actual examples of the concept]*
…
STRATEGIES:
Pr1⇨S1: Evaluate effectiveness of existing Shopfront education enterprises and develop plan for improvement, perhaps integration with other forms of democratization of learning
*[meta-data: competitive intelligence, integration, partnership]*
Pr2⇨S1: evaluate effectiveness of existing distance education enterprises and develop plan for improvement, perhaps integration with other forms of democratization of learning
*[meta-data: competitive intelligence, integration, partnership]*
…

**Figure 1:** Design explanation example fragment expressed as a frame

Carroll, 1996). It does not guarantee that design explanations expressed in its terms will be human-centered. It does not guarantee that design explanations structured in its terms will be ontologically profound in the terms of design as an agency in the world as in (Winograd & Flores, 1986) or (Fry, 1999). Nonetheless, the PRInCiPleS framework does serve as a mechanism for structuring designs as explanations, both as a pedagogical device and as a device in the establishment of a community and culture of design practice in our program in Human-Computer Interaction Design at the School of Informatics at Indiana University.

## 2 A Framework for Design Explanations: PRInCiPleS

It is hard to wean students from the idea that the role of HCI/d education is to provide a standard procedure or method that will somehow magically endow their designs, especially designs that incorporate information technology, with sense and value. Since many of our students have backgrounds in information technologies, they are likely to have been exposed to a myriad of models of design process for software, from waterfall to rapid applications development (RAD) to joint applications development (JAD) to stars to spirals. Alternatives to these

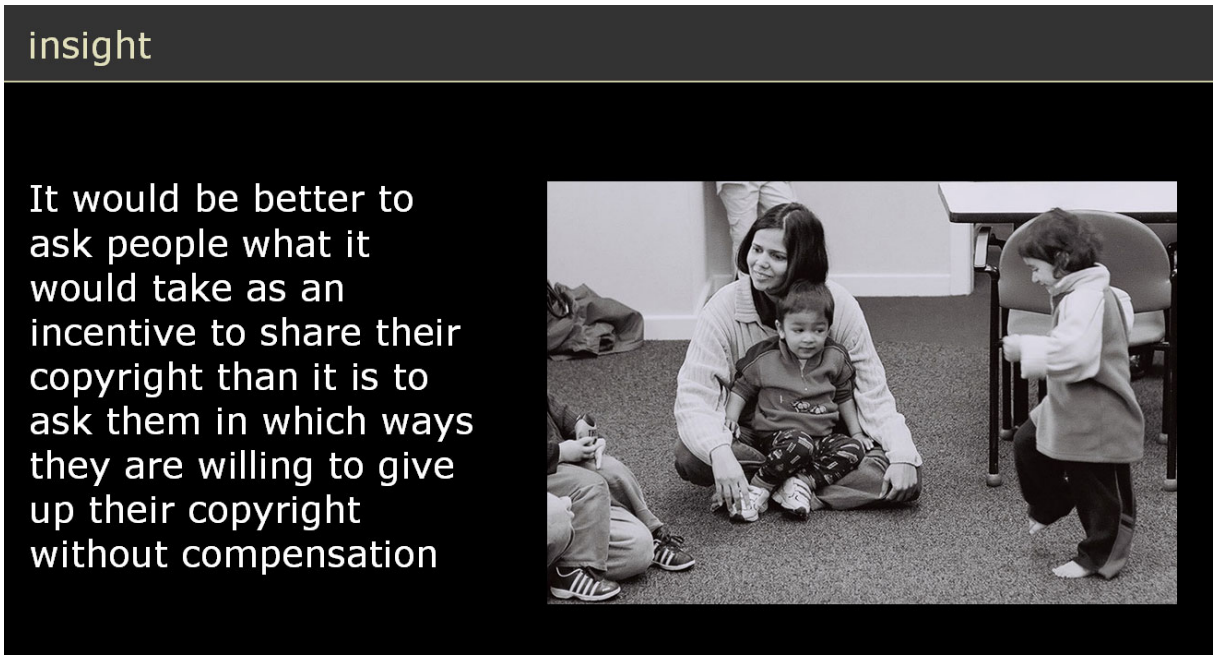


**Figure 2:** Design explanation component example expressed as a slide

models of process that are targeted more at a practice of interaction design are proposed in the textbook we use for HCI for our undergraduate courses (Preece, Rogers, & Sharp, 2002).

The phrase "human-centered design" has many meanings. It is often used to mean that a technology is justified by finding people who are willing to use it. It is often used to mean that software design needs and requirements are based on a cognitive model of human behavior. While these are generally accepted meanings, we want to emphasize a notion of human-centered design in which the technologies follow from human needs and add value to the collective human condition. In our view, a value-rich interpretation of human-centered design means that a design explanation must be justified in terms of how it creates a coherent improvement in our collective human condition. This notion of human-centered design may actually require the removal or re-arrangement of technologies as much as the introduction of new technologies.

In what follows in this section, we describe the different types in the PRInCiPleS framework. We do so with the understanding that the framework is not another alternative procedure for design, but rather simply a container that allows us to bring some consistency to the notion of a design as an explanation in our pedagogical and research contexts. Our goal is to teach and practice human-centered design according to our emphasis on values. The framework facilitates this, but it is not a substitute for a value-rich interpretive discourse and the need to continuously endow each claim in a design explanation with meaning.

Figure 1 illustrates a simplified example of what a design explanation constructed according to the PRInCiPleS framework can look like. The danger of presenting the example in this way is that some readers may construe it as aiming at a level of mathematical formality that is much less important to us than the construction of meaningful content. In our pedagogy, we have sometimes asked students to express design explanations as slide sets as in Figure 2. Elsewhere in these same proceedings, we report on our construction of an open source Wiki-based environment called the Design Exchange which we are using with our graduate students to construct much less formally conceived design explanations that are nonetheless structured according to the PRInCiPleS famework (Blevis, Lim, & Ozakca, 2005). A student-generated and content-rich example of a design explanation component in the form of the Design Exchange appears in Figure 3. The important point is that design explanations are only as convincing as the quality of the argument they denote, and the actual media or level of formality or informality is not particularly important.

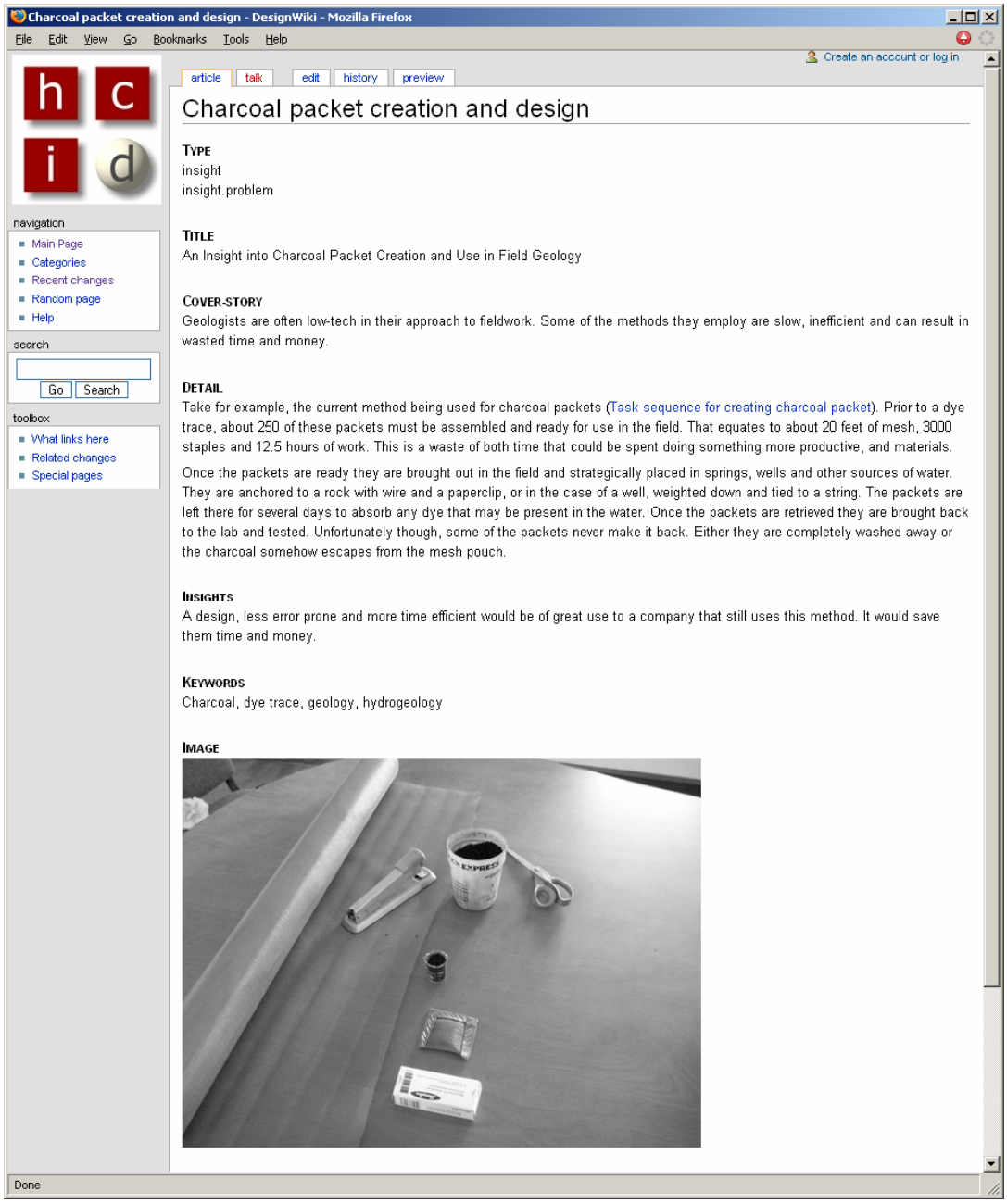


**Figure 3:** Design explanation component example from the Design Exchange Wiki (contents courtesy of Nicholas A. Gentile, used with permission)

## 2.1 Predispositions

By *predispositions***,** we mean nearly tautological statements that represent conventional wisdom or points of view about a group you care about. As a word, "predisposition" means inclination or tendancy to believe a particular thing or hold a particular point of view. We could have used the word "axioms". "Claims", "assumptions", "initial hypotheses" would also have worked. But, there is so much formal baggage associated with these words. Also, in constructing logical or scientific or rational arguments, many people focus on their "own" assumptions. The idea of predispositions is to begin the presentation of design explanations by making sure that all points of view are represented, especially since points of view are often in conflict. So, there is a sense of predispositions in which the

**Figure 4:** Example collection from an office desktop

emphasis in on enumerating various and apparently opposing points of view, rather than on focusing on one's own starting assumptions or personal claims. Here are some predispositions we use to illustrate this notion of conflicting points of view:

Public transportation is more environmentally sustainable than private.
Private places are more comfortable than public ones.

or

Style sells.
Simple is robust.
A simple car with a steering wheel is better than a fancy car without one.

You have no doubt heard it argued that designers tend to enumerate extensively while engineers tend to hone in early on solutions. The notion of predispositions is an attempt to bring designerly culture to a framework for design explanations by encouraging enumeration of all viewpoints from the start. In our understanding of designerly

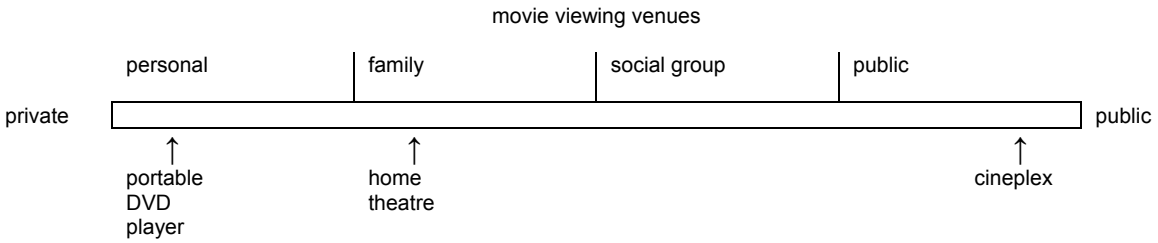


**Figure 5:** A 1-factor diagram for insight development

culture, we believe that many designers include this kind of early enumeration of viewpoints, but the use of the word "predispositions" to describe this practice is our own.

Part of our methodological strategy is to expose conflicting predispositions from the beginning of a designerly undertaking, in order to be more thorough in the pre-concept and pre-prototype research, including literature review, observations, and collections that we describe below.

There is a sense in which the notion of predispositions is targeted to guide designers according to an ethic or value of trying to see all sides of a situation—that a valid design explanation is one which has carefully considered all of the possible sides of a design issue. We believe that values and ethics should be intrinsic to design methods and frameworks—that is perhaps a personal viewpoint. In any event, you need to have some notion of validity; ethics and values or a lack of values and ethics inform that choice one way or another.

There is also a rhetorical sense of predispositions at the presentation stage—by clearly enumerating all possible points of view, you can create early buy-in from a diverse audience. In a business context, choosing the predispositions carefully enables the marketing and the technology and other departments to feel that you are beginning at a point which adequately represents their points of view—and, it also provides according to our notion of designerly ethics, an opportunity to emphasize notions of social value in the enterprise-level discourse.

## 2.2 Research

Design explanations need to be based on an understanding of existing knowledge. To be effective, we hope that the fact that predispositions denote multiple points of view guides research about the existing state of affairs to be more complete than if we had started with a single point of view. We divide the pre-concept research into three types, namely literature, observations, and collections.

| A Design Framework | | | | | |
|---|---|---|---|---|---|
| Analysis | | | Synthesis | | |
| P | R | I | C | P | S |
| Predispositions | Research:<br>Literature<br>Observations<br>Ethnography | Insights | Concepts<br>Systems | Prototypes<br>Exploration<br>Appearance<br>Usability | Strategies |
| ↓↑ | ↓↑ | ↓↑ | ↓↑ | ↓↑ | ↓↑ |
| A Scientific Framework | | | | | |
| Initial hypotheses | Literature search | Research hypotheses | Experiment design | Experiment | Results |

**Figure 6:** Analogies between a Design Framework and a Scientific Framework

*Literature* research and *observations* have the obvious meanings. The techniques of observation that owe to design culture are apparently similar to those that owe to HCI culture and the merge of HCI and design. These include shadow studies, disposable camera studies, documentary photography and videography, beeper studies, laboratory studies, interviewing, surveys, opportunistic observations, courtroom drawings, and so-forth. Such techniques are fully described in practically any textbook on HCI or interaction design, such as (Preece, Rogers, & Sharp, 2002). In our pedagogical context, we council triangulation—the use of multiple techniques to arrive at a more balanced view. Nonetheless, it is incumbent in our opinion on designers to understand the limits of all such techniques, as the very agency of observing under any ethical framework affects the behaviors of those who are observed.

A less obvious technique of pre-concept research is one we call *collections*. By *collections*, we mean the gathering of evidence from the popular culture of things that are primarily inspirational or even whimsical. Many things would not be readily apparent from scholarly literature or direct observation may be revealed by a designerly practice of understanding and collecting items of popular culture. An example we use to illustrate this idea of collections from the popular culture is the Japanese animation cartoon "Speed Racer", which might be used to inform a notion of the comic effect of machines with too many features. Many people have such collections of the artifacts of popular culture on their office desks as in Figure 4. The IDEO "Tech box" is another example of the designerly practice of collecting a variety of things for inspiration in advance of a known purpose (Kelly & Littman, 2001, pp. 142-146).

## 2.3 Insights

An *insight* is an interpretation of research, which may identify a problem with an existing situation or a vision for something better. Figures 2 and 3 are both examples of insights. There are several issues involving the notion of insights in the context of design explanations. First, it helps in the construction of a convincing design argument to separate insights as interpretative discourse from the substance of that discourse, namely research in terms of literature, observations, and collections. Second, insights may be construed as affirmations or refutations of predispositions by means of evidence from research. Thus, an insight and a predisposition may be one and the same thing, in the case that research uncovers affirming evidence for a predisposition. Third, the ordering of predispositions, research, and insights in which insights follow from research which follows from predispositions is a technique of presentation rather than process. In keeping with the notion that PRInCiPleS is a framework and not a process, we need to emphasize that predispositions, research, and insights are actually unordered in terms of their discovery and subject to iterative development. Finally, there are a number of techniques for insight development that may be enumerated, all of which are primarily forms of classification for research literature, observations, and collections; in this list of techniques, we include what we call N-factor models, functional diagrams, object diagrams, and other classification schemes. For example, Figure 5 shows a 1-factor model that classifies movie viewing venues from private to public. The diagram can be interpreted in part as providing an insight that there are not well-known options for movie viewing targeted at social groups larger than family, but smaller than public.

## 2.4 Concepts and Concept Systems

By a *concept*, we mean an idea for a change in an human environment that follows from an insight. By a *concept system*, we mean a number of concepts that work together in concert to create a coherent improvement to a collective human condition

The definitions seem simple enough, but the notion of what is a concept and system of concepts can cause the most confusion, at least pedagogically. The way we have defined concepts systems is inextricably tied to human values, rather than invention or technology. Oftentimes, students in Informatics are inclined to think of things like "PDA" or "Tablet PC" or some other fetishized *objet du jour* of technology as if such things could be concepts. Of course, an object of technology is not a concept in a designerly sense absent a context of use and metric of improvement for the collective human condition. Oftentimes, technologies that are targeted at benefiting a particular consumer group have the effect of creating considerable harm, even if they had been well-intended in the first place—cell phones intended to allow people to reclaim time end up becoming a public nuisance in restaurants and movie theatres; SUVs intended to give people a sense of safety and multiple capabilities end up becoming an environmental nuisance and poster-child of unsustainability. Victor Papanek has said that "there are professions more harmful than industrial design, but only a very few of them" (Papanek, 1984, p.ix). Quite possibly, software and information technology design is one of the few to which Papanek refers. As a more contemporary source, Tom Kelley

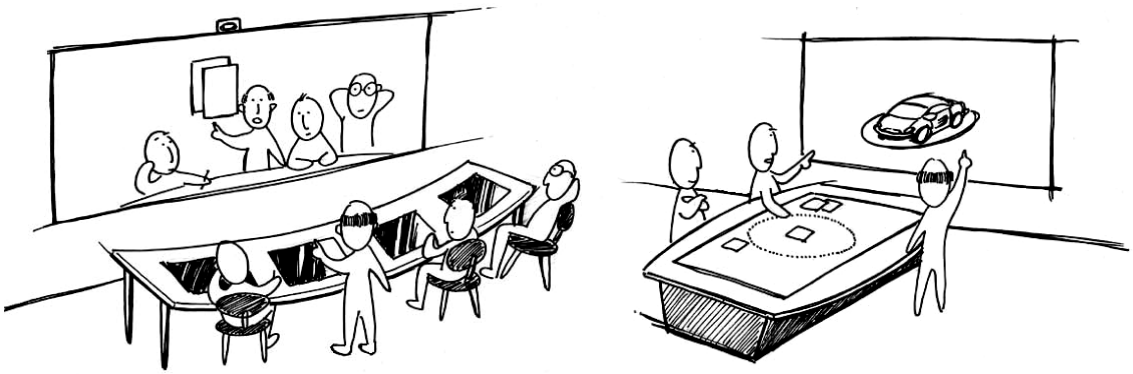

**Figure 7:** Concept Sketches from a Design Explanation about Collocated Collaborative Work
Reproduced from (Wang & Blevis, 2004). Sketches by Hui-wen Wang.

distinguishes invention as technology-centeredness from innovation as human-centeredness and as well writes about design as being the *verbs* and not the *nouns* (Kelly and Littman, 2001).

The language of "design as problem solving" that is popular in information technology circles is possibly the source of some of this confusion. The "problem" with "design as problem solving" is the tendancy of people to think that there is a single optimal solution to everything, that the goal is to find a single solution as quickly as possible, and that problems can be stated clearly in the first place. It would probably be more appropriate to compare design to an idealized notion of scientific method than to problem solving, Figure 6 provides such an interpretation. According to this metaphor, an insight is more like an hypothesis based in secondary research than it is like a problem statement. A concept is more like an experiment design than it is like a problem solution.

By way of an example, figure 7 shows several concept sketches for different systems from a design explanation targeted at supporting collocated collaborative work by industrial designers, from (Wang & Blevis, 2004). These sketches are better understood as designerly ideas for arrangements of technologies and other aspects of an environment to support improved human working conditions in a specific context, rather than as invention of novel technologies. They are about innovative and appropriate use of materials, including the materials of technology, rather than invention.

## 2.5 Prototypes

A *prototype* is a method of expressing a concept or system of concepts, before production. Our usage here is not very different than much of the literature on HCI and design. We distinguish three sorts of prototypes, namely exploration, appearance, and working prototypes. Exploration prototypes are studies that are intended to push and refine a concept rather than test it. Exploration prototypes typically use quick and dirty methods and sometimes called "low fidelity" or "behavioral" prototypes in the HCI literature. Appearance prototypes provide a visual discourse about the look and feel of a concept before production. Working prototypes are ones that work well enough that a task-directed usability study may be conducted. Working prototypes are sometimes called "high fidelity" prototypes in the HCI literature.

## 2.6 Strategies

By *strategy*, we mean an implementation plan for a concept system. We distinguish three sorts of strategic plans, namely enterprise, technology, and social value. An enterprise level strategic plan is an implementation plan that accounts for the marketplace viability of a concept or concept system. A technology level strategic plan is an implementation plan that accounts for the technical feasibility of a concept or concept system. A social values strategic plan is an implementation plan that attempts to predict the social effects of a concept or concept system. One may also construe the notion of a social values strategic plan as being the designerly part of strategy—that is,

the part of the design plan that deals with desirability. To the best of our knowledge, this classification of strategic design in terms of a triumvirate of concerns—enterprise viability, technological feasibility, and designerly desirability—is due to Larry Keely at the Doblin Group design firm in Chicago.

## 3 Summary

In this paper, we have argued that there is much utility in regarding designs as explanations. We have argued about the importance of design as a value-rich discourse about collective human condition. We have provided a framework, called PRInCiPleS, for design explanations that we have used in our teaching as well as our research. We have distinguished the framework as a container for design explanations, rather than a procedure or process. We have argued that the framework is a tool for operationalizing our notion of design as explanation. This notwithstanding, we have also argued that it is incumbent on designers to constantly endow the elements of any design representation with sense and value.

## 4 Acknowledgements

We gratefully acknowledge the contributions of Youn-Kyung Lim, Jeffrey Bardzell, and Yvonne Rogers, as well as Hui-wen Wang, Mark Notess, and Nicholas Gentile. In addition, this work is deeply inspired by the people and tradition of design at the Institute of Design in Chicago, Dale Fahnstrom, Greg Prygrocki, Keiichi Sato, and Patrick Whitney, in particular. Figure 5 in particular arose out of a conversation with John Paolillo.

## 5 References

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). A Pattern Language : Towns, Buildings, Construction. New York. Oxford University Press.

Atwood, M. E., McCain, K. W., & Williams, J. C. (2002). How Does the Design Community Think About Design. *Designing Interactive Systems DIS2002*. London, UK.

Beyer, H., & Holtzblatt, K. (1998). Contextual Design: Defining Customer-centered Systems. San Francisco: Morgan Kaufmann Publishers.

Blevis, E., Lim, Y. K., Ozakca, M., & Aneja, S. (2005). Designing Interactivity for the Specific Context of Designerly Collaborations. *ACM CHI 2005 conference on Human factors and computing systems*. Portland, OR.

Blevis, E., & Siegel M. (2005). The Explanation for Design Explanations. *11th International Conference on Human-Computer Interaction: Interaction Design Education and Research: Current and Future Trends*. Las Vegas, NV

Blevis, E. (2004). What Design Is Matters Less Than What Designs Are: Explanations for HCI and Design, a Case Story. In Zimmerman, J., Evenson, S., Baumann, K., & Purgathofer, P. *Workshop on the relationship between design and HCI. ACM CHI 2004 conference on Human factors and computing systems*. Vienna, Austria. http://k2.iguw.tuwien.ac.at:8080/movabletype/design_hci/

Blevis, E., Y. Rogers, M. Siegel, W. Hazlewood, A. Stephano (2004). Integrating HCI and Design: HCI/d at IUB, a Design Education Case Story. In Zimmerman, J., Evenson, S., Baumann, K., & Purgathofer, P. Workshop on the relationship between design and HCI. *ACM CHI 2004 conference on Human factors and computing systems*. Vienna, Austria. http://k2.iguw.tuwien.ac.at:8080/movabletype/design_hci/

Borchers, J. (2001). A Pattern Approach to Interaction Design. (1st ed.). John Wiley & Sons.

Cross, N. (2001). Designerly Ways of Knowing: Design Discipline Versus Design Science. *Design Issues* (MIT Press), 17(3), 49-55.

Fallman, D. (2003). Designing Design: Design-oriented Human-Computer Interaction. *ACM CHI 2003 conference on Human factors and computing systems*. Ft. Lauderdale, FL.

Fry, T. (1999). A New Design Philosophy: An Introduction to Defuturing. New South Wales, Australia: NSWU Press.

Hubka, V., & Eder, W. E. (1996). Design Science: Introduction to the Needs, Scope and Organization of Engineering Design Knowledge. Berlin: Springer-Verlag.

Kelley, T., & Littman, J. (2001). The Art of Innovation. New York: Doubleday.

Margolin, V., & Margolin, S. (2003). A "Social Model" of Design: Issues of Practice and Research. *Design Issues* (MIT Press), 18(4), 24-30.

Moran, T. P., & Carroll, J. M. (Eds.). (1996). Design Rationale: Concepts, Techniques, and Use. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Notess, M., & Blevis, E. (2004). Comparing Human-Centered Design Methods from Different Disciplines: Contextual Design and PRInCiPleS. *Design Research Society Futureground 2004.* Melbourne, Australia.

Papanek, V. (1984). Design for the Real World: Human Ecology and Social Change. (2nd ed.). Chigaco, IL: Academy Chicago Publishers.

Preece, J., Rogers, Y., & Sharp, H. (2002). Interaction Design: Beyond Human-Computer Interaction. New York: John Wiley & Sons, Inc.

Rogers, Y., Hazlewood, W., Blevis, E., & Lim, Y. K. (2004). Finger talk: collaborative decision-making using talk and fingertip interaction around a tabletop display. *ACM CHI 2004 conference on Human factors and computing systems.* Vienna, Austria.

Schön, D. (1983). The Reflective Practitioner. London: Temple Smith.

Siegel, M. & Blevis, E. (2005). HCI Design Graduate Program at the School of Informatics, Indiana University. In Foley, J., Beaudouin-Lafon, M., Grudin, J., Hudson, S., Hollan, J., Olson, J., & Verplank, B. Workshop on Graduate Education in Human-Computer Interaction. *ACM CHI 2005 conference on Human factors and computing systems.* Portland, OR. http://hcc.cc.gatech.edu/chi2005workshop.htm

Simon, H. (1996). The Sciences of the Artificial (3rd ed.). Cambridge, MA: MIT Press.

Wang, H., & Blevis, E. (2004). Concepts that Support Collocated Collaborative Work Inspired by the Specific Context of Industrial Designers. *ACM CSCW 2004 conference on Computer Supported Cooperative Work.* Chicago, IL.

Winograd, T. & Flores, F. (1986). Understanding Computers and Cognition: A New Foundation for Design. New York: Addison-Wesley, Inc.