Design, Design, and Design

AN OVERVIEW OF STANFORD'S CENTER FOR DESIGN RESEARCH

Wendy Ju, W Lawrence Neeley, Larry Leifer
Center for Design Research, Stanford University

Stanford University's Center for Design Research has been engaged in design research since its founding in 1984. This scope of our research activity spans a broad range of topics related to design, including understanding existing practice, developing emerging technologies, and charting the course of design education. This paper provides a brief overview of research conducted at CDR, and discusses how its approach to design research may differ from that pursued by those in other disciplines.

DESIGN AS A RESEARCH TOPIC

One of the core goals of research at CDR is to find out what is it that designers do when designers do design. To this end, CDR researchers have studied how design teams use their workspaces [1], how designers access and reference information in conceptual design [2], how social interaction affects design outcomes [3], how different learning styles of team members affect group design work [4], how geographical distribution affects design team collaboration [5], how designers use question-asking in the conceptual design process [6], how expert assistance influences design outcomes [7], how design entrepreneurs use informal networks to develop innovative ideas [8], and how design affects the corporate bottom line [9]. This research has contributed to the larger understanding of what design is, has explored how different factors affect the products of the design process, and has influenced how design curriculum should be structured.

DESIGN AS A RESEARCH METHOD

One distinguishing characteristic of CDR research it is conducted by researchers with technical backgrounds in design. This encourages empathy with the subjects of our research, but it also induces researchers to adopt design as a research method. Design is applied to adapt traditional methods for research, providing new tools for data collection and analysis [12]; research on design observatories [11], noun-phrase analysis [13], internet knowledge repositories [14], instrumented workspaces [15] emerged as a natural byproduct of our efforts to understand design. Design researchers are also able to build innovative designs, prototyping the design artifacts of the future to gain insights on the issues, constraints and opportunities which designers will face in years to come. This approach is evident in groundbreaking research on assistive robotics [16], learning technologies [17], drive by wire cars [18], bio-mimetic robots [19]. By employing design as a tool and method for conducting research, we are able to better understand how design occurs, and expand the realm of how design is applied.

DESIGN AS A PHILOSOPHICAL APPROACH

One of the most important aspects of CDR is the emergence and adoption of design as an overall philosophy. This "design thinking" provides a frame from which design students, researchers and practitioners may observe and approach the world at large. Locally, we articulate the three key tenets of this framework as: 1) All design is redesign. 2) Design is a social process. 3) Designers preserve ambiguity.

This framing and philosophy is evidenced in the major themes of CDR research. The notion of "design as redesign," which incorporates our ideas about design being iterative, about design by analogy and situated design, has led CDR researchers to look for external sources of design inspiration; researchers in bio-mimetic design, for instance, are extremely specific about how they study and emulate insects in the creation of bio-mimetic robots; researchers of implicit interactions provide detailed discussions of the human behaviors that interactive products emulate to communicate with users. The emphasis on collaboration, particularly in environments where people are geographically distributed and come from different disciplinary backgrounds, speaks to our belief that design is a social process. Our interest in informal and ad-hoc methods, as well as our history of research in sketching activity as part of the iterative design process, is clearly influenced by the importance of ambiguity as a critical design resource. Our researchers often exploit the ambiguity of what it means to do design research to pick and choose the research methodologies that will best suit the project or question at hand; after all, good designers use whatever tools are at their disposal, and even invent new ones if the situation demands.

Most notably, the principles have profound implications for mixing science and design. Designers, for example, often choose methods in ad-hoc fashion to suit the problem at hand, or adapt their hypotheses on the ground as the situation progresses. This tendency to mix or change methodologies, even goals, on the fly conflicts directly with "proper" scientific protocol; and yet many great inventions are created precisely because people are willing to reframe their questions and goals. At the heart of the difference between design and science is a difference in motivation. To the extent that design research is oriented towards contribution to practice and product, it may not always square with research oriented towards the scientific contribution to knowledge; validity is sometimes sacrificed for value. These tensions do not need to be resolved so much as recognized.

REFERENCES

1. Tang, J. C. and Leifer, L. J. (1988). A framework for understanding the workspace activity of design teams. In Proceedings of the 1988 ACM Conference on Computer-Supported Cooperative Work (Portland, Oregon, United States, September 26 - 28, 1988). CSCW '88. ACM Press, New York, NY, 244-249
2. V Baya, LJ Leifer. (1994). Study of the information handling behavior of designers during conceptual design. In *Design Theory and Methodology*, 68, 153-160.
3. Brereton, M. F. (1998) The Role of Hardware in Learning Engineering Fundamentals: An Empirical Study of Engineering Design and Dissection Activity, PhD Dissertation, Stanford University.
4. Carrizosa, K., and Sheppard, S. (2000) The Importance of Learning Styles in Group Design Work. ASEE/IEEE Frontiers in Education. T2B-12-17
5. Leifer, L., Culpepper, J., Ju, W., Canon, D., Eris, O., Liang, T., Bell, D., Bier, E., Pier, K., "Measuring the Performance of Online Distributed Team Innovation (Learning) Services," proceedings of the ECI Conference on e-Technologies in Engineering Education, Davos, Switzerland, 2002.
6. Eris, O., "Manifestation of Divergent-Convergent Thinking in Question Asking and Decision Making Processes of Design Teams: A Performance Dimension," in Human Behavior in Design, Lindemann, U. (editor), p. 142-153, Springer-Verlag, London, 2003.
7. Eris, O., Leifer, L., "Facilitating Product Development Knowledge Acquisition: Interaction between The Expert and The Team," International Journal of Engineering Education, Vol. 19, No. 1, p. 142-152, 2003.
8. Cockayne, W.R.(2004): A Study of the Formation of Innovation Ideas in Informal Networks
9. Feland III, J.M.(2005): Product Capital Model: modeling the value of design to corporate performance
10. Donaldson, K. (2002) Recommendations for Improved Development by Design. *Development by Design. 2nd International Conference on Open Collaborative Design for Sustainable Innovation. http://www.thinkcycle.org/dyd02*
11. Carrizossa, K., Eris, O., Mabogunje, A., Milne, A., Leifer, L., "Building the Design Observatory: a core instrument for design research." Proceedings of the Design 2002 Conference, Dubrovnik, Croatia, 2002.
12. Leifer, L., and Mabogunje, A., "A Framework for Instrumenting Design Teams," in Designers - The Key to Successful Product Development, H. Birkhofer, P. Badke-Schaub, E. Frankenberger, (Editors), Springer-Verlag, London, Spring 1998.
13. Mabogunje, A, Leifer, L.J., "Noun Phrases as Surrogates for Measuring Early Phases of the Mechanical Design Process," proceedings of the 9th International Conference on Design Theory and Methodology, ASME, Sacramento, California, 1997.
14. Liang, T., Cannon, C., Feland, J., Mabogunje, A., Yen, S., Yang, M., and Leifer, L., "New Dimensions In Internet-Based Design Capture and Reuse," proceedings of the International Conference on Engineering Design, Munich, Germany, 1999.
15. Ju, W., Ionescu, A., Neeley, L., Winograd, T. "Where the Wild Things Work: Capturing Physical Design Workspaces." In Proc. of Conference on Computer Supported Cooperative Work. November 2004. Chicago, IL, 533-541.
16. H.F.M. Van der Loos, J.J. Wagner, N. Smaby, K.-S. Chang, O. Madrigal, L.J. Leifer, O. Khatib, ProVAR assistive robot system architecture, Proc. ICRA, May 10-15, Detroit, MI, 741-746, 1999.
17. Lakin, F., Wambaugh, J., Leifer, L., Cannon, D., and Sivard, C., The Electronic Design Notebook: Performing Medium And Processing Medium,' appeared in a special issue of Visual Computer: International Journal of Computer Graphics, edited by Ranjit Makkuni, Springer Verlag publishers, Vol 5, No 4, August 1989.
18. Gerdes, J. Christian and Eric J. Rossetter (2001) A Unified Approach to Driver Assistance Systems Based On Artificial Potential Fields. ASME Journal of Dynamic Systems, Measurement and Control 123 (3), September, pp. 431-438.
19. S. A.Bailey, J. G. Cham, M. R. Cutkosky, R. J. Full, "Biomimetic Robot Mechanisms via Shape Deposition Manufacturing" in Robotics Research: the Ninth International Symposium, John Hollerbach and Dan Koditschek (Eds), Springer-Verlag, London, 2000.