

Artists in Industry and the Academy: Collaborative Research, Interdisciplinary Scholarship and the Creation and Interpretation of Hybrid Forms

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For a 10 October 1967 press conference, artist Robert Rauschenberg and engineer Billy Klüver wrote a manifesto outlining the aims of Experiments in Art and Technology (E.A.T.) [1]. Printed on light blue paper with cloudlike tufts of white, the manifesto expressed the “urgency... for a new awareness and sense of responsibility” regarding the relationship between art and technology. It warned that industry’s failure to “generat[e] original forethought... and precipitate a mutual agreement” could result in a “cultural revolution,” which would be a “waste”—the antithesis of efficient engineering. The authors asserted that it was unrealistic for art and technology to develop separately and claimed that a “civilized collaboration” between the two would promote the constructive values of “variety, pleasure, ... exploration and involvement in contemporary life.”

In 1966, when Klüver and Rauschenberg organized *nine evenings—theater and engineering*, the landmark event that launched E.A.T., there was greater disciplinary autonomy and insularity than exists today. John Cage, who participated in the event, claimed that the engineer was separate from artists and other people because of “his very highly specialized knowledge” [2]. Similarly, Klüver observed that, as a result of their training, engineers are “locked into a very restricted way of looking at the world,” which prevents them from “using their brains to change the environment, to make a more human environment, as they should” [3]. Over and above Klüver’s specific goal of making “materials, technology and engineering available to any contemporary artist,” E.A.T. created an institutional infrastructure to facilitate and enable communication and collaboration between artists and engineers at a time when practitioners in these disciplines had little or no access to one another either socially or professionally [4]. Ultimately, Rauschenberg believed, the success of E.A.T. could be measured by the extent to which it had become a “redundant organization”—in other words, that artist-engineer collaborations would have become so commonplace that E.A.T. no longer was needed to facilitate them.

To what extent has E.A.T. achieved its goals? What cultural changes and institutional formations have emerged over the last 40 years that facilitate or promote interdisciplinary col-

laborations between artists, scientists and engineers? What lingering or new structural problems hinder such collaborations? The following discussion begins with a brief survey of artist-engineer-scientist collaborations in industry and the academy. Next, a variety of practical and theoretical issues are considered, such as the role of intermediaries who build bridges between various communities, diverging interests between those communities, questions of interpretation and evaluation of the hybrid products and the individuals and teams that create them, and the sustainability of research that lies outside of traditional disciplinary boundaries. Given the increasing dedication of cultural resources to engage artists and designers in science and technology research, there is great need for scholarship that analyzes case studies, identifies best practices and working methods, and proposes models for evaluating both the hybrid products resulting from these endeavors and the contributions of the individuals engaged in them.

INTERDISCIPLINARY RESEARCH IN INDUSTRY AND THE ACADEMY

Zentrum für Kunst und Medientechnologie (ZKM) in Karlsruhe, the Ars Electronica Center in Linz, and the new Artists in Labs program organized by Jill Scott and René Stettler at the Hochschule für Gestaltung und Kunst Zürich (HGKZ) exemplify how the European Union (EU), local governments and advanced scientific research centers in Europe continue to provide substantial support for interdisciplinary research involving artists at full-service media art centers, museums, exhibitions and symposia, and in partnerships with industrial and academic research programs [5]. Also funded in part by the EU, *Poetic Cubs* (Poetic Cubes) is an interdisciplinary collaboration between artists, scientists and other scholars at universities in Spain, England, France and Scotland. Based in Paris, Don Foresta has coordinated the Multimedia Art Research Centers and Electronic Laboratories (MARCEL), a network currently consisting of “100 members in over 17 countries” that uses the Access Grid multicasting platform to enable “artistic, educational and cultural experimentation, exchange between art and science, and collaboration between

ABSTRACT

The author surveys contemporary artist-engineer-scientist collaborations in industry and the academy and considers a variety of theoretical and practical issues pertaining to them. Given the increasing dedication of cultural resources to engage artists and designers in science and technology research, the author concludes that more scholarship must analyze case studies, identify best practices and working methods, and propose models for evaluating both the hybrid products resulting from these endeavors and the contributions of the individuals engaged in them.

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art and industry" [6]. Based in the United Kingdom, Michael Punt has also created a global, transdisciplinary network, the Laboratory for Envisioning Connectivity. The Planetary Collegium, which evolved from the CAiiA+STAR Ph.D. program that Roy Ascott initiated in 1995–1996, offers an international Ph.D. program for art and design researchers through its base at the University of Plymouth and its hub at HGKZ. The Arts Council England has spearheaded *Pioneers of Art and Science*, a project to support interdisciplinary research and the production of documentary resources pertaining to it. The picture in Europe is not entirely positive: In Dublin, Arthouse Multimedia Centre closed in July 2002, and the Media Lab Europe, which supported creative invention across disciplines, closed in January 2005.

In Canada, Banff New Media Institute, funded by a combination of federal monies and corporate partnerships, has supported many collaborations at the intersections of art and technology and also has played a leadership role in promoting metacritical research into the field through the *Beauty of Collaboration* symposium (2003) and the BRIDGES consortium and conferences (in collaboration with the University of Southern California Annenberg Center for Communication, 2001 and 2002), resulting in informative and insightful reports. In the province of Quebec, the Daniel Langlois Foundation, the Société des Arts Technologiques and the new HEXAGRAM Institute for Research/Creation in Media Arts and Technologies (a joint project funded by a Can\$20 million grant shared between Concordia University and the Université de Québec à Montréal) all support various aspects of research and documentation of collaborative work.

In Australia, the Symbiotica art and science collaborative research laboratory was founded at the University of Western Australia at Perth, and the first edition of the Biennial of Electronic Arts Perth (BEAP) took place in 2002. The Interactive Digital Media Matrix (iDMM) was created through a merger between the University of New South Wales and the University of Technology, Sydney. Under the leadership of Jeffrey Shaw, director of the iCinema Centre for Interactive Cinema at UNSW, the iDMM received preliminary funding from the Australian Research Council to support a large-scale, international research consortium that stresses interdisciplinary collaboration in new media, communications technology, cultural theory and cognitive science. In Japan, the InterCommunication Center (ICC), Tokyo; the Institute

for Advanced Media Arts and Sciences (IAMAS), Gifu; and the Media Information Science Laboratories at the Advanced Telecommunications Research Institute (ATR), Kyoto, are supporting interdisciplinary, collaborative research. New programs are emerging as well in Singapore, China and other areas in the Pacific Rim. At the University of Caxias do Sul, Brazil, Diana Dominguez coordinates the Arteco research group, part of the Laboratory of New Technologies in Visual Arts, which has produced many multimedia installations and developed the Pocket Cave (a NAVE, or Non-Expensive Automatic Virtual Environment).

The situation in the United States is marked by an absence of governmental funding and great uncertainty about other forms of institutional support. Resources comparable to ZKM, Ars Electronica, Banff New Media Institute, iDMM or the ICC do not exist in the United States, although organizations such as Art Science Collaborations Inc. (ASCI), Boston Cyberarts Festival (and ARTCOM program), the Kitchen and Eyebeam Atelier help support networking, exhibitions, residencies and symposia. The publication in spring 2003 of the report *Beyond Productivity: Information Technology, Innovation, and Creativity*, sponsored by the National Research Council with support from the Rockefeller Foundation, offered hope that more governmental interest in this area would be forthcoming [7]. However, the agenda of the January 2004 convocation on interdisciplinary research convened by the National Science Foundation in Washington, D.C., did not include any discussion of the role that artists, humanists or even social scientists might play in collaborative research. The handful of humanists and social scientists in the audience voiced their disappointment about this omission.

Intel is currently the most visible and generous corporate sponsor of artistic research collaborations [8]. Prestigious, corporate-sponsored programs at Interval Research and Xerox PARC ended abruptly in 1999 and 2000, respectively. A joint project between Lucent Technologies and the Brooklyn Academy of Music supported the development of *Listening Post*, by Bell Laboratories statistician Mark Hansen in collaboration with independent artist Ben Rubin in 2002. Lucent no longer supports such projects, and Hansen left Bell in 2003 for a professorship at UCLA, where he holds a joint appointment in Statistics and Design Media.

Although corporate artist residencies and project sponsorship require broad

support from within an institutional framework, often it is the vision, talent and work of individuals that generate such programs. Max Matthews and Billy Klüver played such a role at Bell Labs in the 1960s. From its inception in 1993, the Xerox PARC Artists-in-Residence program (PAIR) was spearheaded and directed by Rich Gold, whose own background bridged the arts and industry and who was able to communicate in both languages. Similarly, Intel's sponsorship of artistic research emerged from the vision and leadership of Dana Plautz, who also has an interdisciplinary background. Sara Diamond has noted that such individuals play a vital role in enabling interdisciplinary research involving artists by justifying industry's investment in them, convincing colleagues of their value, and intermediating between the interests of individuals and institutions and between artists, engineers and scientists [9]. It is unclear what combination of personal and managerial qualities makes for successful intermediaries, or what conditions would lead to identifying and cultivating more of them, but such catalysts may play an increasingly important role in the future of interdisciplinary research.

Despite their largesse, it would be naive to imagine that industry partners invite artists into their labs or provide funding for the sole purpose of research. In artworks such as *On Social Grease and Mobilization* (1975), Hans Haacke poignantly revealed how supporting the arts can whitewash a company's tainted image, transforming it into a corporate good citizen. By accepting corporate sponsorship, Haacke later argued, artists and cultural institutions become complicit in supporting the interests of capitalism and globalization [10]. Nonetheless, it is difficult to imagine a "pure" place of operations where artists can produce and exhibit work that is autonomous from economics [11]. For some artists, whose practices demand access to and participation in the development of emerging technologies, there may be little option but to rely on corporate, public or institutional partners. At the same time, individual artists have succeeded in producing technologically complex work, and alternative spaces have presented it without relying on such support.

The embrace of artistic collaborations by national and university scientific research laboratories is somewhat more novel. Similarly, one must consider the possibility that such labs also seek to enrich their public image by an association with the arts and/or utilize artist fellowships and residencies as an efficient

means for producing concrete forms that communicate abstract and complex scientific concepts to broader audiences. Such motivations are particularly germane to research that is the subject of public debate, e.g. nanotechnology, genetic engineering, military technology, or that is a conspicuous consumer of public funds but has produced scant tangible output, e.g. particle accelerators for high-energy physics [12].

After a wave of intense public fascination with art and technology that peaked around 1968, American universities became important centers for ongoing experimentation in this field. Founded in 1973, the Electronic Visualization Lab at the University of Illinois, Chicago, has been a seedbed for interdisciplinary research, including the collaborative creation of the CAVE in 1992 by a team that included artist Dan Sandin [13]. Also in 1973, Charles Csuri founded the Computer Graphics Research Group at the Ohio State University, which later expanded in 1984 to become the Advanced Computing Center for the Arts and Design. Since 1979, the Interactive Telecommunications Program at New York University has supported research on and development of alternative media. Artist Donna Cox has participated in myriad interdisciplinary collaborations that involve "renaissance teams" at the University of Illinois at Urbana-Champaign, where she has held a joint appointment with the School of Art and Design and the National Center for Supercomputing Applications since 1985 [14]. Despite an uncertain relationship with art and artists, the Massachusetts Institute of Technology Media Lab, founded in 1985 as an outgrowth of the Architecture Machine Group, is perhaps the best-known academic program for interdisciplinary invention at the nexus of technology and culture.

An explosion of artistic and public interest in art and technology occurred in the 1990s, spurred by the availability of personal computers and user-friendly software and further buoyed by a general fascination with technology amidst the e-commerce boom. U.S. universities are increasingly recognizing the importance of interdisciplinary research and the value of art and design as bona fide research fields that have much to contribute to science and engineering [15]. Artist researchers have demanded a terminal degree that creates parity with other scholars who hold a Ph.D. These factors have combined to fuel the proliferation of academic programs that support doctoral research involving collaboration between artists, engineers and scientists [16].

CRITICISM, HISTORY AND INTERDISCIPLINARY COLLABORATION

Although 18th- and 19th-century aesthetic theories asserted the autonomy of art, the development by artists of one-point perspective, anatomy studies, photography and virtual reality attest to the deeply intermingled histories of art, science and technology. Moreover, throughout history, artists have created and utilized technology to envision the future, not just of art, but of culture and society in general. Unfortunately, the history of art has neglected to incorporate this visionary conjunction of art and technology into its canon in any systematic way. Just as the insights afforded by diverse methodologies, ranging from feminist theory to Marxism to post-structuralism, have resulted in substantial revisions of the art-historical canon, so the history of art must be revised in a way that explicitly addresses interactions between art, engineering and science. This revision will be required not just because it corrects an obvious omission but because contemporary artists are increasingly employing science and technology as artistic media. As such work enters more mainstream artistic practice and becomes embraced by galleries, museums and other cultural institutions, the need for contextualizing it within a larger history will demand the production of that narrative. The increasing frequency of scholarly publications in the field suggests that this process has already begun. In order to facilitate research in this area, a bibliography of interdisciplinary collaboration has been made available on-line [17].

The initial growth of graduate programs that support advanced research involving interdisciplinary collaboration emerged through the pioneering efforts of visionary artists, engineers, scientists, other scholars and administrators. Its current expansion is being fueled in part by market demand from students who believe that an interdisciplinary education will best prepare them for the creative challenges of the present and future. To serve this demand, the greatest numbers of new faculty hires in art departments at U.S. universities are in the interdisciplinary field of media art. Administrators are increasingly coming to recognize that multimedia development is a growth area for the education market as well as for global economic markets, and that corporate and foundation support of graduate research in this area can provide substantial external funding. Leading contemporary artists in the United States are now directing interdisciplinary grad-

uate programs at major U.S. research institutions that are training a generation of hybrid artist/engineer/scientists, some of whom have entered the professoriate [18]. As their numbers increase, their impact on the centrality of technology and science in the practice of art and design (and vice versa) will also force a reconsideration of the canons of art history and the histories of science and technology. One hopes that such work will create new forms of structure and meaning that expand the languages of art, design, engineering and science, and that open up new vistas of creativity and invention.

In order to understand the evolving relationship between art and technology in contemporary art (and vice versa), one must grapple with the complex processes and products that sustain and result from these collaborations. Scholarship in this arena will require an interdisciplinary approach that joins together humanistic methods of interpretation with social science methods of analysis. One might imagine a historian or critic simultaneously acting as ethnographer and management consultant or collaborating with social scientists to undertake research. Despite the wealth of interdisciplinary research being undertaken, and despite the general recognition that there are substantial challenges to collaboration across disciplines, there is scant metacritical research that studies best practices, working methods and contextual supports and hindrances. It is unclear, for example, to what extent models of interdisciplinary collaboration currently employed in industry can be applied to university research contexts. If the academy is serious about interdisciplinary collaboration, then it must dedicate resources to study these issues and to develop guidelines, training methodologies and project management techniques that will help fulfill the promise of interdisciplinarity. As recent scholarship produced by psychologist Brigitte Steinheider and artist George Legrady suggests, collaborations between artists, engineers and scientists furnish a valuable test-bed for such research, while interdisciplinary analysis offers an insightful approach to its evaluation [19].

Artists, designers, scientists and engineers who collaborate together must, on some level, share or develop a common language, negotiate mutually rewarding goals, establish clear communications and effective knowledge sharing and develop a scheme for project coordination and management [20]. The need for shared languages and goals raises many questions, not only for the collaborators,

but for cultural critics and historians who wish to analyze and comment on them. If a goal of these collaborations is the creation of hybrid forms—what have been referred to as “boundary objects”—that transcend the disciplinary limits of any single field, then the evaluative methods particular to a given discipline may not offer adequate measures of success or failure. New methods for ascertaining the value of the hybrid outcomes of interdisciplinary collaboration must be developed just as new methods for teaching, cultivating and recognizing the value of hybrid scholars must emerge. Perhaps even new forms of critical and/or historical exegesis and means of publication and distribution must be developed to articulate and convey the meaning and significance of evolving forms of interdisciplinary creation.

On a philosophical level, if the fruits of hybrid research are not strictly science, or engineering, or art, then one must wonder about the epistemological and ontological status of these hybrid forms: What exactly are they? What new knowledge do they produce or enable? What is their function in the world? On a practical level, the future sustainability of hybrid research depends on answering these questions, because the academic careers of scholars whose work fuses disciplines will be cut short if their contributions are not recognized and rewarded within the university. In order to pursue interdisciplinary collaboration as a full-time career, Klüver was forced to quit a lucrative and secure job at Bell Labs and rely on philanthropic sources to fund E.A.T. and provide for his livelihood. If universities are unable to adopt appropriate methods for evaluating and granting tenure to interdisciplinary professors, they will create a disincentive for future scholars to pursue interdisciplinary work, disrupt the ability of existing interdisciplinary faculty to mentor future hybrid researchers and prevent the ascension of interdisciplinary faculty to positions of power and authority in academe, where they can influence infrastructural change and facilitate the creation of new forms of invention, knowledge and meaning.

References and Notes

1. The statement was published without title or attribution in *E.A.T. News* 1, No. 3 (1 November 1967), p. 5. During an interview in Berkeley Heights, NJ, U.S.A., on 22 August 1997, Klüver made a gift to the author of one such press conference statement, on

the back of which he wrote, “These are our ‘Aims.’ R² [Robert Rauschenberg] wrote sentence 1 and 3 and I wrote number 2.” E.A.T. project manager Julie Martin, in correspondence with the author on 2 March 2005, recounted Klüver’s story of co-authorship with Rauschenberg but explained that the statement was a group effort, warranting collective attribution to E.A.T.

2. Experiments in Art and Technology, “Trailer Introducing Ten Documentary Films from 9 evenings: theatre & engineering, October 13-23, 1966.” VHS. Author’s transcription of Cage’s oral statement.

3. Billy Klüver, telephone interview with the author, 19 September 1997.

4. *E.A.T. News* 1, No. 1 (15 January 1967), p. 2.

5. Jeffrey Shaw, who, as Director of Visual Media at ZKM, helped gain EU funding, has noted that “enlightened administrator” is not an oxymoron in the European context; rather, visionary administrators in Brussels recognize the broad and important implications of supporting the intersections of culture and technology, particularly of an international nature (Jeffrey Shaw, interview with the author, 24 November 2002, Karlsruhe).

6. Joel Chadabe, “About MARCEL: Arts Electric Interviews Don Foresta,” 4 February 2005 <<http://www.arts-electric.org/articles/050204.foresta.html>>. See also <www.mmmarcel.org/intro.htm>.

7. Other notable U.S. reports include: Michael Century, “Pathways to Innovation and Culture” (report commissioned by the Rockefeller Foundation, 1999); Craig Harris, ed., *Art and Innovation: The Xerox PARC Artist in Residence Program* (Cambridge, MA: MIT Press, 1999); Pamela Jennings, “New Media Arts/New Funding Models” (report commissioned by the Rockefeller Foundation, 2000); Michael Naimark, “Truth, Beauty, Freedom, and Money: Technology-Based Art and the Dynamics of Sustainability” (report commissioned by the journal *Leonardo* and supported by the Rockefeller Foundation, 2003). Rockefeller Foundation reports available at <<http://rockfound.org>>, under the Creativity and Culture program’s Convergence of Art and Digital Media section.

8. See Dana Plautz, “New Ideas Emerge When Collaboration Occurs,” *Leonardo* 38, No. 4, 302–309 (2005).

9. Sara Diamond, “Degrees of Freedom—Models of Corporate Relationship: When Should ‘Hands-Off’ Be ‘Hands-On,’ When ‘Hands-On,’ ‘Hands-Off’?” Paper delivered at the panel “Artists in Industry and the Academy: Interdisciplinary Research Collaborations,” 2004 College Art Association Annual Conference, Seattle, Washington. See also Diamond’s article, “Degrees of Freedom: Models of Corporate Relationships,” in this issue of *Leonardo*.

10. Hans Haacke, “Museums, Managers of Consciousness,” in Rosalyn Deutsche, et al., *Hans Haacke: Unfinished Business*, Brian Wallis, ed. (New York and Cambridge, MA: New Museum and MIT Press, 1985) pp. 60–73.

11. Edward Shanken, “The House That Jack Built: Jack Burnham’s Concept of Software as a Metaphor for Art,” *Leonardo Electronic Almanac* 6, No. 10 (November 1998). <<http://mitpress.mit.edu/e-journals/LEA/ARTICLES/jack.html>>.

12. I am grateful to Jill Scott for an enlightening discussion of these matters, Zürich, 6 May 2004.

13. CAVE stands for Computer Automatic Virtual Environment. Other collaborators included Carolina Cruz-Neira, Tom DeFanti, Robert Kenyon and John Hart.

14. See Donna Cox, “Renaissance Teams and Scientific Visualization: A Convergence of Art and Sci-

ence,” in *Collaboration in Computer Graphics Education, SIGGRAPH '88 Educator's Workshop Proceedings* (New York: ACM, 1988) pp. 81–104.

15. The University of California (UC) system is at the forefront of this wave. Leading artists, engineers and scientists on the faculty include: Ken Goldberg, Greg Niemeyer and Warren Sack at UC Berkeley; Rob Nideffer, Celia Pearce and Simon Penny at UC Irvine; Rebecca Allen, Christian Moeller and Victoria Vesna and her collaborator, nano-scientist Jim Gimzewski, at UCLA; Jordan Crandall, Natalie Jeremijenko and Ruth West at UC San Diego; and George Legrady and Marcos Novak at UC Santa Barbara. A wide range of centers, institutes, networks and collaborations span across multiple UC campuses, including the UC Digital Art Research Network (UC DARNet), Center for Information Technology Research in the Interest of Society (CITRIS), Center for Research in Computing and the Arts (CRCA), California Institute of Information Technology and Telecommunications (Cal-(IT)²) and the Digital Cultures Project.

16. As in industry, visionary individuals have played an important role in catalyzing the creation of these new programs, which include the Digital Arts and Experimental Media (DX Arts) program directed by Richard Karpen and Shawn Brixey at the University of Washington; the Digital Media program at Georgia Tech’s School of Literature, Communication, and Culture, with interdisciplinary faculty including Diane Gromala, Jay David Bolter, Janet Murray, Eugene Thacker and Sha Xin Wei; and the Media, Art, and Technology program at UC Santa Barbara, spearheaded by George Legrady (slated for fall 2005). Other notable U.S. graduate programs include the Arts Computation Engineering program directed by Simon Penny at UC Irvine, which has proposed a Ph.D. program; the Arts, Media, and Engineering program directed by Thanassis Rikakis at Arizona State University, the Design Media program (MFA) led by Victoria Vesna at UCLA, and the Art and Technology program (MFA) led by Ken Rinaldo at the Ohio State University. The recent creation of the Center for New Media at UC Berkeley and current construction of the Experimental Media and Performing Arts Center at Rensselaer Polytechnic Institute further indicate a dedication to interdisciplinary research involving artists at U.S. universities.

17. See <http://artextra.com/biblio_interdisciplinary.html>.

18. For example, Rob Nideffer, Associate Professor of Studio Art and Information and Computer Science at UC Irvine, earned a Ph.D. in sociology with an interactive CD-ROM dissertation, perhaps the first of its kind. He fulfilled his thesis requirements for an MFA in studio art with an on-line artist’s book, a hard-copy book of code, a special issue of the on-line journal *Speed* and a physical installation. <<http://proxy.arts.uci.edu/~nideffer/vitae.html>>.

19. Brigitte Steinheider and George Legrady, “Interdisciplinary Collaboration in Digital Media Arts: A Psychological Perspective on the Production Process,” *Leonardo* 37, No. 4, 315–321 (2004).

20. See Steinheider and Legrady [19] and Ruth West et al., “Both and Neither: *in silico* v.1.0, *Ecce Homology*,” *Leonardo* 38, No. 4, 286–293 (2005).

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