THE HISTORY AND FUTURE OF THE LAB:

COLLABORATIVE RESEARCH AT THE INTERSECTIONS OF ART, SCIENCE, AND TECHNOLOGY

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in A Plohman and C Butcher, eds. Future of the Lab. Eindhoven: Baltan, 2010.

Forthcoming in Spanish in proceedings of 9th New Frontiers of Science, Art, and Thought. Barcelona, 2011.

Forthcoming in Polish by Centrum Cyfrow Projekt (Digital Center) Warsaw, 2012.

I. I HAVE SEEN THE FUTURE AND IT DOESN'T WORK

Journalist Robert Fulford's cynical quotation about the future may appear to be an inauspicious way to begin a discussion about the future of the lab. However it also offers useful insight. The point is not that experimental labs dedicated to broad transdisciplinary collaboration at the intersections of art, science and technology are doomed to failure. Rather, I suggest that conventional criteria are insufficient for determining whether or not they work. If a key goal of these labs is the creation of hybrid forms that transcend the disciplinary limits of any single field, that push conventional structures of knowledge and yield breakthrough innovations, 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 outcomes of collaborative research – and for recognising the importance of process as an outcome in and of itself – must be developed.

Harvard Business School professor Lee Fleming has noted that, 'a creative team … [comprised] of very similar disciplines … will be unlikely to achieve a breakthrough,' whereas a more diverse one (e.g. joining art, science, and engineering) 'is more likely to achieve breakthroughs,' though with a greater proportion of insignificant outcomes[1]. If the media labs of the future want to generate breakthroughs, they must take extraordinary risks and be willing to fail most of the time. It would be unrealistic, therefore, to hold them to ordinary expectations about success and success rates. But we should also expect that every now and then these labs will work extraordinarily well, offering breakthroughs that would not have been made otherwise. I hope to revel as much in a lab's failures as in its tangible successes and I encourage others to embrace these failures as a symbolic indicator of a lab's success in pursuing the extraordinary. Indeed, as the following example of Bell Labs and 9 evenings: theatre and engineering suggests, some of the biggest flops in history provide some of the future's brightest successes. A second case-study of historical artist-engineer collaborations at Philips Corporation offers further lessons that future labs should heed with respect to preserving their pasts for the future to build on.

II. PREDICTION IS VERY DIFFICULT, ESPECIALLY ABOUT THE FUTURE: BELL LABS, 9 EVENINGS, E.A.T.

Physicist Niels Bohr's ironic aphorism about the future offers ironic insight into the challenges that the present faces in recognising what the future will valorize from the past. This insight is particularly relevant with respect to cutting-edge research that heralds new forms of practice, such as those undertaken in experimental labs, whose outcomes do not easily fit established norms and evade conventional evaluative rubrics. Throughout history, the present has demonstrated a remarkable inability to recognise what its most important contributions to the future will be. With this observation in mind, we must take into account that the outcomes and modes of operation of experimental research, although seemingly banal today, may be the breakthroughs of tomorrow.

In its heyday, Bell Labs was arguably the premier scientific research facility in the US. Seven Nobel Prizes have been awarded for work completed there, and it can claim bragging rights for diverse theories and technologies, including the transistor, laser, information theory, the UNIX operating system, and the C and C++ programming languages. Bell Labs was also the site where pioneering work in computer music, computer graphics, and computer animation took place, largely under the auspices of John Pierce, Executive Director of the Research-Communications Principles division. Known as the "father of the communications satellite", Pierce also supervised the team that invented the transistor, a term that he coined. He not only co-authored a landmark report on pulse code modulation (the basis of digital audio)[2] but penned a number of science fiction novels and popular articles including "Portrait of the Machine as a Young Artist", which appeared in Playboy in 1965.[3] In 1955, electrical engineer Max Mathews joined Pierce at Bell, which sponsored his early forays into computer-generated music (it then cost $200/hour to rent time on an IBM computer). The early music synthesis techniques Mathews developed earned him recognition as the "father of computer music". In 1961, Pierce brought composer James Tenney to Bell as an artist-in-residence, where he worked closely with Mathews until 1964, further developing

the possibilities of digital sound synthesis. Other artists in residence included Stan VanDerBeek and Lillian Schwartz, who worked closely with computer scientist Ken Knowlton, developing computer animation in the 1960s and 70s. Having worked with artists including Jean Tinguely, Jasper Johns, and Robert Rauschenberg since 1960, Bell Labs engineer Billy Klüver gained Pierce's approval to allow his staff to collaborate with artists on the production of the now famous event, 9 evenings: theatre and engineering, which took place in New York in 1966.

At that time, art and engineering were far more autonomous fields than they are today. There would have been no professional or cultural reasons for artists and engineers to encounter each other, much less collaborate together. One could seriously ask, as Klüver did then, 'Have you ever met a normal, healthy and working engineer who gives a damn about contemporary art? Why should the contemporary artist want to use technology and engineering as material?'[4] It was in this context that Klüver framed 9 evenings as a 'deliberate attempt by ... artists to find out if it was possible to work with engineers.' Importantly, this modest aim did not propose grandiose outcomes in terms of technical and artistic achievements but rather strove to investigate whether or not it was even possible for these two disciplines to collaborate together.

With this goal, ten leading contemporary artists and thirty Bell Labs engineers worked together for ten months on a series of now legendary performances, generating several patents in the process. Seen by an audience of over 10 000, the project benefitted from 8 500 hours of engineering expertise (donated by the engineers, not the Lab), some "midnight requisitions" (presumably unauthorised) from Bell, and significant personal donations from Klüver, Rauschenberg, and others. As Klüver noted, everyone's 'investment in terms of putting-yourself-out-on-a-limb was considerable.' Indeed, given that the aim focused on exploring the possibility of working together, the risk of failure for such an elaborate and high-profile event was exceedingly high, with the reputations of many renowned individuals and Bell Labs at stake.

Despite the collaborators' superhuman efforts, critics' accounts of 9 evenings are remarkable for their insistence on the failure of the event. By most, it was considered a flop. They complained of extended delays and poor sound quality; that the technology did not work and that even when it did, it was underwhelming. The performances were panned for their lack of artistic merit. The artists complained that the engineers did not understand their needs and could not solve the technical problems quickly enough. The engineers complained that they did not get enough credit, that the artists did not understand the complexity of the technical challenges their artworks posed, and that they did not have enough time to solve them. Klüver complained that the critics had only attended the shaky opening nights and that they, like much of the audience, did not understand what they had seen, frequently confusing technological and artistic features. ‘Anything that was assumed to have gone wrong (whether it actually did or not) was attributed to technical malfunctions.’ He claimed that the, ‘engineers did a fantastic job – by any standards’ and that, ‘Half the performances were more or less completely successful; others suffered from a few failures which were by no means as catastrophic as the critics implied.’

This confused and conflicted reception had very little impact on the event’s success in popularising and capturing the public’s imagination about the idea of artist-engineer collaborations. During the process of organizing the 9 evenings, the not-for-profit organisation Experiments in Art and Technology (E.A.T.) was formed in order to make ‘materials, technology and engineering available to any contemporary artist.’[5] E.A.T. helped coordinate a number of important artist-engineer collaborations, including prize-winning commissions featured in the exhibition, The Machine: As Seen at the End of the Mechanical Age (New York, MOMA, 1968), and the Pepsi Pavilion, a multimedia marvel seen by over a million visitors at EXPO ’72 in Osaka. At its peak, E.A.T. could boast of twenty-eight chapters in the US and some 6000 members. Moreover, E.A.T’s activities, and 9 evenings in particular, have served as a vital inspiration for artists’ investigations of emerging technologies for over four decades, gaining legendary stature as new media art becomes increasingly prevalent and integrated into mainstream contemporary art. E.A.T.’s copious archives, including extensive photographic and video documentation, are accessible in several repositories

and offer a rich source of information about the organisation and the early history of artist-engineer collaborations.[6]

III. THE FUTURE AIN’T WHAT IT USED TO BE: PHILIPS, CYSP I, POÈME ÉLECTRONIQUE, SENSTER

American baseball legend Yogi Berra’s oft-quoted aphorism expresses remorse at the loss of optimism that was formerly associated with the future. It also suggests that what once looked shiny, new, and futuristic – like fins on automobiles – later become the quaint objects of nostalgia. This inevitable destiny plagues the future of the future, to use John McHale’s term. In light of this humbling recognition, how can we preserve the essence of our own forward-thinking visions and practices – both the historical, cultural contexts in which they emerge and the crucial lessons learned through experimental processes of grappling with the unknown – so that future generations can learn from and build upon them?

Philips Corporation, based in Eindhoven, is a leading European electronics firm, with particular strengths in lighting and consumer electronics, especially audio. Important inventions include the compact cassette tape in 1963, the compact disk, which it launched with Sony in 1982, and the DVD, introduced in 1996. Philips has a long and distinguished history of innovative collaborations with artists. Compared with Bell Labs and 9 evenings, the works generated achieved a remarkable degree of success and recognition in its time. Yet much of that work has perished, including many of the archival records that would provide scholars and artists with deeper insight into the processes and outcomes of these early collaborative projects.

In 1956, Philips engineers helped Nicolas Schöffer create CYSP I, which employs an “electronic brain” connected to sensors that enables the human-scale kinetic sculpture to respond to changes in sound, light intensity and colour, and movement, including that of the audience. The whole sculpture moves on four rollers, while its sixteen polychrome plates pivot and spin at different rates depending on external stimulus. It premiered in a performance with the

Maurice Bejart dance company, interacting with the dancers on the roof of Le Corbusier's Cité Radieuse, accompanied by concrete music composed by Pierre Henry. This early responsive, robotic sculpture is perhaps the first work of art to explicitly incorporate the principles of cybernetics (CYSP is an acronym formed from the first two letters of the words cybernetic and spatiodynamic). It has had an extensive exhibition history and the sculpture survives in the artist's estate.

Not long after Schöffer's successful collaboration, Le Corbusier was commissioned to design the Philips Pavilion for the 1958 World's Fair in Brussels. Based on sketches of hyperbolic paraboloids executed by his assistant, architect and composer Iannis Xenakis, Corbusier supervised the creation of a stunning building that served as a showcase for Philips's technological innovations in light and sound. Xenakis's composition Concrèt PH was heard upon entering and exiting the pavilion. Inside, Corbusier produced a remarkable visual montage comprised of a black and white film, three projectors, and a changing pattern of coloured lights. Synchronised with the film, Edgard Varèse's three-channel music composition, *Poème Électronique,* incorporated a wide range of sounds from machine noises and vocals to electronic tones. Developed at Philips's labs, using the latest electronic technology, Varèse's music was reproduced on a spatialised sound system consisting of some four hundred speakers mounted throughout the structure.[7] As Marc Treib has written, this landmark integration of architecture, film, music, light, and electronics presented a 'liturgy for twentieth-century humankind, dependent on electricity instead of daylight and on virtual perspectives in place of terrestrial views.'[8] Unfortunately the pavilion was destroyed soon after the fair was over, leaving scholars with the challenge of piecing together fragmented documentation to theoretically reconstruct a sense of the actual embodied experience of a tightly integrated synthesis of space, sound, and image.

Another important early art-engineering collaboration sponsored by Philips also has been lost: Edward Ihnatowicz's Senster, which was continuously displayed for four years at the company's Evoluon exhibition hall beginning in 1970. Also produced as a showpiece of Philips's futuristic engineering skill, this four meter, robotic sculpture was controlled by a computer connected to sensors including sound and radar, which enabled it to respond to the sound and movement of the audience. Dismantled in 1974, the electronic components appear to have been given away at the time, and, with the exception of some photographs, Philips's archives related to the Senster were destroyed. As of 2003, the mechanical structure was displayed as an outdoor sculpture next to the engineering company that obtained it. Unanimated and decontextualised, the welded steel armature remains but a weathered ghost of a highly responsive surrogate being that in its prime enchanted thousands, providing them with a glimpse into the future.[9]

IV. THE FUTURE IS HERE. IT'S JUST NOT WIDELY DISTRIBUTED YET

Novelist William Gibson's well-known aphorism that heads this section suggests that the future of experimental labs and collaborative research is here, now, and that the issue is less a matter of existence than of spreading and disseminating it. Indeed, the precursors discussed above, in combination with the success of large institutional labs and cultural centres, such as MIT Media Lab, Ars Electronica Future Lab, and ZKM, laid the foundation for growing cultural investment in labs like BALTAN, which have proliferated internationally over the last couple decades.

So what can we learn from Bell Labs, E.A.T., and Philips? How can that help us plot a path to the future? The success of an extraordinary, transdisciplinary project often cannot be gauged at the moment of its creation. Its reception will likely be confused and contradictory. Those who lack expertise in the key fields contributing to it will have difficulty evaluating it in either artistic or scientific terms, much less in framing its potential historical significance. As Florian Schneider has observed, 'Collaborations are the black holes of knowledge regimes. They willingly produce nothingness, opulence, and ill-behaviour. And it is their very vacuity that is their strength....It does not entail the transmission of something from those who have to those who do not, but rather the setting in motion of a chain of unforeseen accesses.' It is into these vacuous black holes that the labs of the future must boldly plunge, enabling the unforeseen to emerge in its opulent nothingness. However, in a cultural context that is mediated by a bottom-line mentality that demands justification in quarterly reports, experimental labs must facilitate translation not just between artists and scientists but between visionaries and accountants.

Venture capitalist funds invest in highly risky start-up companies with extraordinary growth potential and expect only a very small percentage of them to actually achieve extraordinary success. But even if only one in a hundred is a huge success and yields one thousand times the investment, the VC will realise a tenfold increase in value. It must be noted that VC firms are highly selective, reject some 98% of projects proposed, and often play an instrumental role in managing the fledgling company. Similarly, media labs and those who invest in them should expect only a very small percentage of their projects to achieve extraordinary success. They must institute rigorous selective criteria and develop the expertise and resources to help nurture projects to achieve extraordinary success. Like VC firms, which pool the funds of many investors, media labs could also pool their investments together in order to spread risk and resources and to share in the success. Perhaps this strategy points toward how the future of the lab, following Gibson, is to become more widely (and evenly) distributed.

The collaborations at Bell and Philips demanded inspired and visionary leadership from technologists and corporations as well as from artists and foundations. Similarly, participants today must be willing to take risks, to cross boundaries, and to collaborate in unconventional ways that involve 'putting themselves out on a limb,' as Klüver noted. They must be ready to deal with the challenges of translating across disciplines that employ very different descriptive languages, methodologies, and goals. Inevitably misunderstandings will arise, tensions will build, and egos will be bruised. Such conflicts should be embraced as a crucial and creative catalyst for innovation. Werner Heisenberg remarked that, 'in the history of human thinking the most fruitful developments frequently take place at those points where two different lines of thought

meet.' But it is frequently at the points of friction between two different lines of thought that the most innovative breakthroughs occur. Such creative frictions demand that transdisciplinary teams forge hybrid forms of knowledge production that generate insights and results that could not have been achieved by using the methods and techniques of any single discipline.

It is a supreme understatement that transdisciplinary collaboration is difficult. It requires extraordinary commitment from individuals and groups that are so dedicated to the idea that they are willing to volunteer their time, resources, and expertise to them, taking it largely on faith that the outcome – which could not be anticipated in advance – will be worth the effort. It is as much a matter of fastidious project coordination and of managing and motivating people, as it is a matter of inspiration and creativity. It takes time for a collaborative team to develop a shared language with which the members can communicate across disciplines and to identify suitable boundary objects that serve as the common locus of their research. And it takes time to develop trust in one's colleagues, particularly colleagues from other disciplines, and to develop an effective and efficient mode of collaborating together. Team members must believe in each other and in their shared vision, even when their work is misunderstood by the public and panned by critics and colleagues, even when their labours might not result in an exhibition-worthy artwork or peer-reviewed article. In the context of the mid-1960s, when few of the artists and engineers had ever interacted with practitioners in the other field and did not meet each other until shortly before the event, it is truly remarkable what the collaborators in the 9 evenings were able to achieve in less than a year. It is perhaps an equally remarkable symbol of Klüver's commitment to the idea of pursuing artist-engineer collaboration as a full-time career that he quit a lucrative and secure job at Bell Labs and relied on philanthropic sources to fund E.A.T. and provide for his livelihood.

On a philosophical level, if the fruits of experimental research are not strictly art, science, or engineering, 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 such research depends on answering these questions, because the labs themselves, like the careers of artists and scholars whose work fuses disciplines, will be prematurely curtailed if their contributions are not recognised and rewarded. As an integral part of their mission, labs must develop rigorous criteria for evaluating and documenting the processes and products of the transdisciplinary collaborations they facilitate. They must develop compelling rationales for the importance of such research as an engine for innovation – innovation not just as an immediately marketable commodity but as constituting more subtle and perhaps more insidious and profound shifts in the conception and construction of knowledge and society. Labs must also play a pivotal role in cultivating broader public recognition of the cultural value ofresearch at the intersections of art, science, and engineering and in helping to make resources and expertise more widely distributed. Ultimately, Rauschenberg believed, the success of E.A.T. could be measured by the degree to which it had become a "redundant organisation" – in other words, that artist-engineer collaborations would have become so commonplace that E.A.T. no longer was needed to facilitate them. To a large extent, E.A.T. has achieved success as gauged by Rauschenberg's criteria. Artists and engineers do not need an intermediary organisation to play matchmaker. Similarly, the success of the new wave of experimental labs may be measured by their future redundancy: that the current challenges, such as evaluative criteria, recognition of scientific and cultural value, and ubiquitous distribution, will be solved.

FOOTNOTES

1 – Lee Fleming, *"Perfecting Cross-Pollination" Harvard Business Review (Sep 2004).*

2 – BM Oliver, JR Pierce, CE Shannon, *"The Philosophy of PCM," IRE Proceedings, Vol. 36, November 1948, pp. 1324–1331.*

3 – Mark Ballora, *INART 55 – History of Electroacoustic Music, Bell Labs in the 60s (website)* http://www.music.psu.edu/Faculty%20Pages/Ballora/INART55/bell_labs1960s.html *(Cited 12 June 2010). In the mid-60s, Playboy was highly respected for its literary content, with contributors including Jean-Paul Sartre, Kurt Vonnegut Jr. and Vladamir Nabakov.*

4 – Billy Klüver, *"Theater and Engineering, an Experiment: 2. Notes by an engineer," Art Forum (February, 1967). Reprinted in Edward A. Shanken, Art and Electronic Media (London: Phaidon, 2009): 266-67. Unless otherwise noted, all quotes from Klüver come from this source.*

5 – E.A.T. News 1:1 (January 15, 1967); *2. Officially incorporated in 1967 by Klüver and Bell Labs colleague Fred Waldauer, together with Rauschenberg and artist Robert Whitman.*

6 – *These include the Getty Research Institute in Los Angeles and the Daniel Langlois Foundation in Montreal.*

7 – "Edgard Varèse's Poème Électronique." *Programme notes from Masterpieces of 20th Century Music: A Multimedia Perspective. Low Library, Columbia University, 2000.* http://music.columbia.edu/masterpieces/notes/varese/notes.html *Cited 20 May, 2010.*

8 – See Marc Treib, *Space Calculated in Seconds. (Princeton: Princeton University Press, 1996): 3.*

9 – *See* http://www.senster.com. *Website edited by Alex Zivanovic. Cited 19 May, 2010.*

10 – Florian Schneider, *"Collaboration. Seven Notes on New Ways of Learning and Working Together," 2007.* http://www.kein.org/node/89 *Cited 20 September, 2010.*