

## 6 CONCLUSIONS: RETHINKING COOPERATIVE INNOVATION

The thesis began with a critical challenge: “How should we create an environment that supports global interdisciplinary cooperation towards open design innovation in critical problem domains?” I suggested that there is an urgent need today to expand the mandate for cooperative R&D in sustainable development and design to ensure greater support for, what I consider, *Universal Human Rights*. The Appropriate Technology movement in the 1970’s pioneered radical thinking towards localized, sustainable and socially motivated design innovations, however the movement had limited impact as it failed to mobilize both local and global organizations, industry and the research community in bringing worthy innovations from concept to market. Several emerging trends and conditions today including networked computing and distributed collaboration, renewed interest in sustainable development and greater openness in intellectual property rights, allow us to consider novel approaches towards globally-relevant problems in critical domains.

In this thesis I have suggested that sustainable design innovation can benefit from multi-disciplinary cooperation among diverse organizations and experts facilitated by online platforms, studio design courses, peer-reviewed publications in conferences and novel intellectual property models. The thesis work was grounded in a three main areas of research: *Cooperation*, *Community* and *Intellectual Property*. The key principles and assumptions embodied within these themes were further explored in the thesis research, while several conflicts and challenges emerged during this process.

### **ThinkCycle: Open Collaboratory for Sustainable Design Innovation**

The ThinkCycle initiative began at MIT in 2000 with a modest goal of archiving well-posed challenges and ongoing design solutions in an online database, for use by faculty and students conducting real-world projects in university engineering courses. A collaborative online system was developed to provide community tools and shared spaces for students, domain experts and stakeholders to discuss, exchange and construct design solutions in critical domains. ThinkCycle continues to grow as a distributed community and open public domain site to support ongoing cooperation, peer review and global dissemination of innovative ideas in sustainable design.

The key challenges and questions for this thesis research are summarized as follows:

- Understanding the role of collaborative online platforms for distributed design and problem solving in critical domains. How should such systems be designed to be scaleable and support the diverse needs of users worldwide? What are the key social and technical challenges for sustaining a distributed online community?
- How can we develop design curricula and linkages with real-world problem domains to provide university students with opportunities for research and working experience in sustainable design and development? How can communities of practice emerge from co-located or distributed design teams, domain experts and stakeholders? How should online platforms support the needs of such communities of practice?
- While an online system may allow distributed participants to cooperatively develop design innovations, how do innovators deal with the resulting intellectual property concerns? What are the social incentives and conditions that change the nature of protection and dissemination of individual and cooperative design innovations? What are the emerging intellectual property patterns and how can they be better supported?

Clearly many of these questions cannot be fully evaluated within the limited scope and timeframe of the thesis work, however even within such a limited setting I believe insights and concerns have emerged, which must be carefully considered in future research, particularly as the initiative is scaled-up beyond university settings. In this concluding chapter, I summarize the principle lessons learned and open research directions for future work.

### ***Developing Online Collaboration Platforms***

The design of the ThinkCycle online collaboration platform has evolved through several stages of system design with ongoing user feedback over a period of 16 months. The system remains primarily structured around topics or problem domains of interest, which serve as community knowledge repositories in areas of sustainable design. Within topics, there are online project spaces (or ThinkSpaces) for distributed design teams, with public and private access to content posted. This serves as a means to archive, manage and track ongoing design iterations.

ThinkCycle provides an open digital library for peer-review and publication of papers submitted to the international *development by design* conferences. In addition to the structured online forums for collaboration, content archiving and knowledge dissemination, ThinkCycle supports informal modes for discussion, peer-review and interaction. While the early prototypes demonstrated the basic concept, a functional and robust system required a great deal of software engineering and iterative system design before there was sufficient user adoption to gain critical mass (by mid-2002). The system has gradually evolved from an online information archive to an online platform for distributed communities engaged in cooperative design. ThinkCycle now has nearly 2000 registered members who have contributed hundreds of content postings, reviews and discussions in dozens of Topics and ThinkSpaces created on the site.

While the software system and online community continues to expand, a number of critical insights and challenges have emerged:

- Though an online system must provide sophisticated functionality for collaboration and community tools, it must also match user expectations of simplicity, ease of use and integration with existing forms of communication like email.
- Asynchronous design interactions and searchable online archives complement face-to-face synchronous work among localized groups. However speed of access in low-bandwidth settings and need for regular design updates must be addressed with lightweight web and email-based solutions and asynchronous client tools for access and uploading designs, which do not require continuous web connectivity.
- The need for structured interaction vs. informal social mechanisms must be carefully balanced to design a system that allows users structure and flexibility to browse and contribute diverse forms of content and support open dialogue in a sustained manner.
- Social norms and conventions among communities of practice emerge over time. Any cooperative system must provide sufficient flexibility for such norms to shape the overall nature of the community, while one must recognize the norms imposed by its own design.
- Product design is a social process; hence social mechanisms for awareness, access and iterative design among local or distributed participants must be supported.

The greatest challenge for a novel online platform like ThinkCycle has been proactively dealing with the *ongoing co-evolution of system design and user expectations*. While the ThinkCycle architecture and applications have grown extensively over a span of 16 months, the level of adoption and ongoing usage by an online user community has somewhat been slower. An online community platform must be robust and provide a few distinctively useful features at the onset, for lead adopters to readily embrace it and actively sustain its usage, encouraging others to join. Design of extensive content structure and interaction mechanisms must be carefully balanced with user expectations and interests. A small-scale lightweight system that grows its structure and interaction protocols over time, with ongoing usage and feedback from the user community has a better chance of being adopted more readily. This requires great attention to users needs and emerging requirements, while developing a flexible underlying architecture so that the system and its interface may be adapted more easily. After several design iterations, the ThinkCycle online platform has evolved to meet most user expectations for functionality, robustness and scalability, though the high-level structure and interaction requires some familiarity for novice users. Overall, it appears that the design of a large collaboration system must evolve gradually with the needs and interests of its distributed online community, while continuing to explore innovative applications and novel interaction mechanisms.

### ***Establishing Sustainable Design Curricula in Universities***

As part of the ThinkCycle initiative a global network of studio design courses were conducted at MIT as well as universities in India, Brazil, Kenya and Portugal. Faculty and students in these courses worked with stakeholders in the field and domain experts in industry to develop socially relevant design innovations. Several projects from the MIT studio, *Design that Matters*, have been patented or licensed, while two projects received MIT IDEAS and Lemelson Technology awards in 2002. One project on Low-Cost Eyewear won the Collegiate Inventors Award and is being commercialized by a startup venture with graduates from the Harvard Business School.

I developed the online collaboration platform while I co-taught studio courses focusing on sustainable design at MIT in 2001 and 2002. To examine the nature of collaborative design, learning outcomes and social attitudes of students participating in such studio courses, I initiated a study consisting of online surveys, intensive interviews and case studies of design projects.

Online surveys and interviews were conducted with 17 students who participated in the spring 2001 and 2002 studio courses at MIT. The study provides a qualitative assessment of student attitudes towards learning and collaboration in this setting. The responses suggest a number of key themes for studio courses: 1) courses focusing on sustainable design through hands-on learning have a broad appeal among students, 2) an important element of such real-world design courses is establishing meaningful linkages with external domain experts and organizations, and providing students opportunities for fieldwork, 3) the success of such courses requires commitment from faculty to provide academic legitimacy and active involvement of instructors and domain experts in mentoring group projects.

For online collaboration platforms, the responses indicate: 1) online tools focusing on sustainable design are useful for sharing and archiving designs, and have a role in dissemination and problem solving however they are most valuable when teams or domain experts are not always co-located, 2) the overhead for usage by busy engineering students must be minimized by simplified interfaces and greater integration with existing channels of communication like email, 3) in addition to improved navigation, many users requested tools for *asynchronous content updates* and *real-time chat*. Overall responses suggest that users view design as a *social process* rather than only that of archiving and exchanging data.

Another successful studio course was conducted by faculty among several schools in Bangalore, India. Interdisciplinary teams developed several design concepts and working prototypes related to household composting, rainwater harvesting and energy efficient stoves. While the Bangalore students used ThinkCycle to archive some project-related work and publications, there was distinctly lower online usage observed. The primary reasons seem to be lack of ongoing high-bandwidth connectivity in the schools, unfamiliarity with the online platform, lack of remote peer-review community and most importantly a preexisting culture of face-to-face design interaction. No formal study was conducted with the Bangalore students as their course was only completed in December 2002, however detailed assessment by faculty and students in the future would reveal greater insights into the nature of design interaction, online usage and learning outcomes.

It is important to recognize that the learning and cooperative design outcomes of such applied studio courses cannot be easily quantified. In different settings, the culture of pedagogy, design process, linkages with field organizations and educational objectives dictate the nature of design outcomes. While some general curricular materials, standards and objectives can be adopted among different schools and universities, I believe design curricula must be carefully developed by faculty within the culture and environment of the pedagogical setting and localized problem domains. However, we have encouraged faculty and students across schools to share and peer-review experiences from design projects through the online platform and by submitting publications to the *development by design* conferences. Participation in ongoing workshops, working in shared problem domains and cooperative design projects among schools will encourage greater learning from diverse studio courses on sustainable design held worldwide.

### ***Understanding Intellectual Property Rights in Open Collaborative Design***

With the emergence of ongoing design projects on ThinkCycle, one finds a variety of seemingly perplexing or contradictory attitudes and approaches towards dissemination and protection of design innovations. As part of the thesis, I conducted a study to examine the social perceptions of property rights and nature of IPR policies adopted among product innovations in university settings. I examined 7 case studies of product innovations from the *Design that Matters* Studio course offered in spring 2001 and 2002. Intensive interviews were conducted with 10 students from the studio course, while additional interviews with 3-4 university researchers were also conducted to validate some of the findings. The outcomes from these interviews inform the analysis of IPR for open collaborative design. There is an opportunity to develop novel mechanisms that support multiple views of IPR for greater innovation in critical problem domains.

The preliminary analysis suggests that despite the ambiguity surrounding property rights among student innovators, they seem to have clear and strong rationale for dealing with IPR questions. There are diverse and reasoned notions surrounding patents, suggesting many important attributes that informants seek such as recognition, control, learning, preemptive protection and enabling commercial production of their work. However, there is surprisingly greater ambiguity and skepticism about Open Source policies, being regarded as noble or academic exercise rather than an operational IPR policy. All informants are not clearly convinced that Open Source policies can be adopted in hardware design, and there is a sense that the social reciprocity of cooperative design is not always emphasized in the process. However for many participants working on design innovations in sustainability areas, Open Source represents the normative approach that is initially adopted. Several factors influence changes in IPR approaches adopted by innovators, including 1) recognition of innovations as being “under the radar”, 2) deferred or territorial scope of patents, 3) institutional biases and stakes in the project and 4) the role of formal or informal social contracts.

In examining the 7 projects in the study I find them aligned within a typology of four emerging IPR patterns based on level of public disclosure and formal/informal nature of IPR desired. In the thesis I describe the key characteristics and rationale for adopting each of these patterns.

- *Informal-Public IPR*: This is essentially a form of Open Source dissemination online, though no licensing mechanism is adopted. Most design projects on ThinkCycle are initiated in this pattern and at least a third of them remain in such status, primarily because the project is subpatentable or innovators have low stakes in the outcomes.
- *Informal-Private IPR*: Many innovators choose not to reveal all ongoing design experiments publicly until they have validated their findings. Hence they maintain contributions in private shared online spaces, while not seeking formal patents. Unless aspects of the designs are gradually disclosed, this IPR pattern can be considered the most extreme form of protection i.e. a Trade Secret.
- *Formal-Public IPR*: Some innovators when approached by companies to license their design innovations may choose to patent their work, even if previously disclosed, as long as it is within 1 year of disclosure. Innovators argue that by patenting, yet keeping innovations public they provide companies incentive for manufacture while being able to retain some control over the quality, specifications and usage of their innovations.
- *Formal-Private IPR*: A few innovators choose to keep their design concepts under private access, while seeking patents. This is primarily done when innovations are considered patentable and “above the radar” of commercial interests, such that protection becomes important. These innovators also wish to take a greater personal stake in the outcomes.

Innovators find themselves moving among these patterns over the lifecycle of a project, based on the nature of design outcomes and emerging patentability or personal stakes desired in an innovation. Hence we must consider the incentives and mechanisms that support diverse models of intellectual property rights, particularly among distributed participants of cooperative innovations.

Several approaches and policies that can be adopted to support both formal and informal IPR for critical design innovation, summarized here:

1. Considering institutional support for diverse IPR models (particularly in universities).
2. Establishing prestigious awards for sustainable design innovation.
3. Creating forums for publication and peer-review of research in sustainable technology.
4. Supporting online project design spaces with moderated access, like ThinkSpaces.
5. Maintaining a digital “paper trail” of design contributions from distributed participants.
6. Establishing a global registry for subpatentable innovations, as an alternative to patents.
7. Creating novel and flexible online licensing mechanisms to support diverse IPR patterns.

Overall, the study of social attitudes and incentives towards intellectual property models is a fascinating and productive area for ongoing research. I believe neither Open Source nor Patents are an appropriate solution for all design innovations developed online, however a range of mechanisms that provide varying attributes and incentives from both, need to be considered. Key insights and novel models developed on ThinkCycle must be carefully assessed and implemented, such that some generalized approaches for collaborative design in distributed online settings may emerge.

### ***Future Work: Expanding Cooperative Innovation in the Commons***

Increasingly as many more design projects emerge with ThinkCycle, particularly ones spanning institutional boundaries with participants worldwide (not unlike the open source software movement), a number of critical issues must be resolved to support innovation:

- What technical and social mechanisms allow academia, industry and the nonprofit sector to cooperate in sustainable design projects, while ensuring mutual benefits?
- How can design teams with participants from multiple institutions and geographic regions cooperate, manage, exchange and resolve the design process and property rights?
- What kinds of social contracts and licensing schemes support cooperative innovation, while providing open peer review, protection, dissemination and ability to commercialize?
- How can small-scale or subpatentable innovations be documented, disseminated and commercialized through a global registry with network of companies and entrepreneurs?

To address these questions, I would propose setting up experimental design studios spanning several universities worldwide. Design faculty from each institution could run the courses, along with the participation of selected Non-governmental Organizations (NGOs) in developing countries, and local industry partners. Up to five problem domains would be selected and student/expert teams will be formed across institutional boundaries with geographically dispersed participants. There would be some shared lecture sessions, as well as opportunities for face-to-face interaction in workshops or joint fieldwork. Participants would be urged to exchange and peer review designs using ThinkCycle online platform and collaboration tools.

In preparation for the collaborative studios, we would expand the online design tools, gather sustainable design curricula and case studies/projects for the design teams, setup industry and nonprofit linkages in specific problem domains, and institute a variety of IPR mechanisms for sharing and protecting their design innovations. This pilot experiment would reveal the challenges for distributed collaboration in product design, nature of learning and patterns/conflicts in models of IPR adopted by different participants. One can also examine strategies for field deployment, dissemination of results as well as private entrepreneurship and commercialization.

The key questions to study would include: 1) the benefit and limitations of online platforms in the design process, 2) the role of industry and nonprofit partners in the design outcomes, 3) the conditions under which certain cooperative design projects fail or succeed, 4) approaches for integrating sustainable design collaboration in university curricula, 5) the IPR policies that ensure the appropriate balance between protection and sharing among participants, and 6) effective mechanisms for field deployment, dissemination and commercialization of designs. Studies would

be conducted in several stages, using online surveys, intensive interviews, analysis of online design interactions and deployment of design innovations developed by distributed participants.

Over the past two years, students taking the *Design that Matters* studios at MIT and Bangalore have developed many sustainable innovations, which have been field-tested, patented and licensed, while one is being commercialized by a startup venture. Clearly such initiatives may continue to yield socially relevant design solutions and novel product innovations. However, these innovations must be supported in terms of field-deployment, entrepreneurial assistance, industry partnerships and suitable models for intellectual property protection and licensing.

Each year thousands of small-scale design innovations developed worldwide lack appropriate expertise and resources for evaluation, field deployment or commercialization. The research conducted in these university settings should allow one to help develop appropriate frameworks that support cooperative innovation between academia, industry, the nonprofit sector as well as grassroots innovators. ThinkCycle is emerging as a collaborative platform, open design repository and global community for innovations in sustainable design. Over the next few years it may be beneficial to further develop this initiative as a nonprofit entity, the *ThinkCycle Foundation*, dedicated to supporting distributed cooperation in sustainable innovation, and new models of education, intellectual property and product deployment. Ongoing conferences like *development by design* provide a global forum for educators, researchers and practitioners to create a supportive community in critical problem domains.

In this thesis I have argued for expanding the scope of cooperative R&D towards sustainable design innovation to ensure Universal Human Rights. As part of the thesis research, I have outlined the critical challenges, implemented concrete approaches and conducted studies to better understand the social nature of resulting outcomes. Through such initiatives one can continue to develop architectures, platforms and models for distributed collaboration, support communities of practice in global problem domains, and conduct research on novel intellectual property mechanisms to support cooperative innovation in the commons.

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## APPENDIX

### **Online Questionnaire for Study on Collaboration and Learning**

A study was conducted on collaborative design and learning in the MIT design studios held in 2001 and 2002. As part of this study participants were asked to answer questions in an online survey and intensive interviews. This is an early version of the 5-part online questionnaire with 60 questions. For many questions, a 5-7 point *Likert scale* was used to provide a series of statements to which participants could indicate degrees of agreement or disagreement (shown as 1-5 below). After a pilot test, the online survey was revised; some questions were refined and 20 additional questions were added to the new online survey (not shown below).

#### **A. Demographic Information**

1. Current Academic Status (Undergrad, MS, PhD, Graduated)
2. Degree Major
3. Age
4. Gender

#### **B. General Attitudes towards Collaboration and Course Projects**

5. I prefer to work independently on assignments and projects than in groups. (rate 1-5)
6. I feel that working with others on assignments and projects is more helpful than working alone. (rate 1-5)
7. The last time I was involved in a group project, I was found it to be an enjoyable and worthwhile experience. (rate 1-5)
8. I view the field of my design project as intensely competitive. (rate 1-5)
9. I don't want to share my project designs openly, because others may use it without much credit or benefit to me. (rate 1-5)
10. I don't want to share my project designs openly, because my ideas are too premature for others to review. (rate 1-5)
11. I don't want to share my project designs openly, because it takes too much effort to do so. (rate 1-5)

#### **C. Course Evaluation (only applicable to participants in studio courses)**

1. Why did you decide to take this studio design course?
2. The course exceeded my expectations for what I had hoped to learn? (rate 1-5)
3. The course significantly changed my approach towards socially conscious design? (rate 1-5)
4. The course provided me with valuable experience and skills for real-world projects. (rate 1-5)
5. The course gave me a very good understanding of the problems and challenges in designing appropriate technologies in the real world. (rate 1-5)
6. I found the instructors helpful in teaching and mentoring projects. (rate 1-5)
7. I found the guest speakers engaging and insightful. (rate 1-5)
8. I found the student peer-reviews and collaborations helpful towards my project. (rate 1-5)
9. I found my interaction with external domain experts and organizations, during my project to be very productive. (rate 1-5)
10. Rate your learning experience in this course relative to other project-based design courses you have taken. (rate 1-5)
11. I felt that doing the projects for this course was a frustrating and unproductive experience. (rate 1-5)
12. I wish to seriously continue working on my project even after the course is completed. (rate 1-5)
13. Rate the difficulty of this course relative to other project-based design courses you have taken. (rate 1-5)
14. Rate your attendance and participation in the class sessions. (rate 1-5)
15. I consider this course to be very time-consuming. (rate 1-5)
16. How many hours a week on average did you spend on this course outside class? (less than 5, 5-10, 10-20, 20-30, more than 30)
17. I consider this course to be intensely competitive. (rate 1-5)
18. I recommend this course be offered as part of the university curricula for credit to all students in the future. (rate 1-5)
19. What were the best outcomes of this course for you?
20. What suggestions can you make to improve the course?

#### **D. Access and Experience with Online Tools**

21. How would you rate your proficiency with the Internet? (novice, casual, experienced, expert)
22. Where do you access the Internet most frequently? (home, campus, work, public places, other)
23. Usually how fast is your Internet connection? (slow and unreliable dialup modem, fast dialup modem, cable/DSL service, high-speed T1 line)

24. How often do you access the Internet? (several times a day, once a day, once a week, every month)
25. How often do you check your email? (several times a day, once a day, every week, every month)
26. How often do you use instant messaging or chat? (never, several times a day, every week, rarely)
27. Have you used any web-page authoring or online collaboration tools before? If so which ones?
28. Have you created your own websites or web pages? If so, please list some sample URLs here.

**D. Attitudes towards using ThinkCycle (only for participants using ThinkCycle)**

**Basic Usage and Usefulness**

1. How often do you visit the ThinkCycle site? (several times a day, once a day, once a week, every month, rarely)
2. Do you believe this online platform is a useful tool? (rate 1-5) If so Why?
3. What aspect of this platform do you find most useful? (open-ended)
4. Did you find the tool very complicated or confusing to use? (rate 1-5)
5. Did you find using the tool very time consuming? (rate 1-5)
6. What aspects do you find most difficult, confusing or time consuming to use? (open-ended)
7. Did you find it necessary to review the ThinkCycle tutorial? (rate 1-5)
8. Did you find it necessary to ask the instructors or peers how to use ThinkCycle? (rate 1-5)
9. When did you use ThinkCycle most often during the course? (open-ended)

**Reviewing Content**

10. I find that viewing and searching content on ThinkCycle is useful. (rate 1-5)
11. How often do you view content online? (several times a day, once a day, once a week, every month, rarely)
12. What sort of content do you view most frequently? (open-ended)
13. I like reviewing and commenting on content posted by others. (rate 1-5)
14. I find comments on my content posted by others useful. (rate 1-5)
15. You posted XXX Comments & XXX Cross-Links? What do you think prevents you from posting more comments and cross-links regularly?

**Posting Content**

16. I find that posting ongoing resources, links and concepts for my project on ThinkCycle is useful. (rate 1-5)
17. How often do you post content online? (several times a day, once a day, once a week, every month, rarely)
18. What sort of content do you post most frequently? (open-ended)
19. You posted XXX notes? What do you think prevents you from posting your content on ThinkCycle regularly? (open-ended)
20. You are subscribed to XXX forums and you posted XXX messages? What do you think prevents you from using the discussion forums to post messages regularly?

**Concluding Question**

21. Do you think using ThinkCycle contributed towards helping you on your design project? (rate 1-5). If so, please state how OR if not, please describe why?

## Understanding the Role of Online Tools and Social Incentives Towards Collaborative Design & Learning in Studio Courses

Consent for Participation in Study and Use of Questionnaire and Audio-taped Information

*Principal Investigator: Nitin Sawhney, {nitin@media.mit.edu}*  
MIT Media Laboratory, May-June 2002

This study is being conducted to assess the nature of collaborative design and learning outcomes from individual and team projects in experimental design studios and the use of an online collaboration platform, ThinkCycle. The study solicits voluntary participation in an online questionnaire, optional follow-up interviews and an optional focus group discussion.

I fully understand that my participation in the study is voluntary and that I am free to withdraw my consent and discontinue participation at any time without prejudice to myself. The procedures and purposes of the study have been explained to me and the investigator has offered to answer any inquiries concerning them. I understand that I may voluntarily answer questions in the online questionnaire and that I have no obligation to answer every question. I may also separately agree to be interviewed as a follow-up to this questionnaire, if needed in the future. My identity and all personal information expressed by me will be kept anonymous in any reporting by the researchers. My participation or non-participation in this study will in no way affect grades assigned to me on any courses I am enrolled in at my university. For my participation in this study I will receive a free T-shirt, even if I choose to withdraw from the study early.

If I am asked for a follow-up interview, I understand that my interview will be audio taped if I give permission to the investigators. However, I can still participate in the study if I choose not to be audio taped. The audiotapes will only be heard by the investigators for subsequent transcription and analysis, unless I specify otherwise. All audiotapes will be stored in a locked cabinet, accessible only to the investigators. In the unlikely event that it is impossible to provide such secure storage space, the audiotapes will be destroyed.

In the unlikely event of physical injury resulting from participation in this research, I understand that medical treatment will be available from the M.I.T. Medical Department, including first aid emergency treatment and follow-up care as needed, and that my insurance carrier may be billed for the cost of such treatment. However, no compensation can be provided for medical care apart from the foregoing. I further understand that making such medical treatment available; or providing it does not imply that such injury is the Investigator's fault. I also understand that by my participation in this study I am not waiving any of my legal rights. For further information contact the Institute's Insurance and Legal Affairs Office at 253-2882.

I understand that I may also contact the Chairman of the Committee on the Use of Humans as Experimental Subjects, M.I.T. 253-6787, if I feel I have been treated unfairly as a subject.

I agree to be interviewed after the questionnaire if needed:                      Yes\_\_\_\_                      No\_\_\_\_

I agree to be audio taped in this follow-up interview:                      Yes\_\_\_\_                      No\_\_\_\_

I agree to let the investigators contact me in the future:                      Yes\_\_\_\_                      No\_\_\_\_

Address\_\_\_\_\_ Phone\_\_\_\_\_

Name\_\_\_\_\_

Signature\_\_\_\_\_ Date\_\_\_\_\_

Principle Investigator\_\_\_\_\_ Date\_\_\_\_\_

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## E D U C A T I O N

**Awarded the Martin Fellowship** with the MIT Laboratory for Energy and the Environment (2002/2003)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA (1998 - 2003)  
Ph.D. MIT Program in Media Arts and Sciences, Human Design Research Group  
*Thesis: Cooperative Innovation in the Commons: Rethinking Distributed Collaboration and Intellectual Property for Sustainable Design Innovation*

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA (1996 - 1998)  
M.S. MIT Program in Media Arts and Sciences, Speech Interface Group  
*Thesis: Contextual Awareness, Messaging and Communication in Nomadic Audio Environments*

GEORGIA INSTITUTE OF TECHNOLOGY, Atlanta, GA (1993 - 1996)  
M.S. Information Design and Technology with Certificate in Management of Technology  
School of Literature, Communication, and Culture and School of Management  
*Thesis: Authoring and Navigating Video in Space and Time: An Approach Towards Hypervideo*

GEORGIA INSTITUTE OF TECHNOLOGY, Atlanta, GA (1989 - 1993)  
Bachelor of Industrial Engineering  
School of Industrial and Systems Engineering

## W O R K E X P E R I E N C E

MITSUBISHI ELECTRIC RESEARCH LABORATORY (Summer '99)  
Cambridge, MA

Worked with researchers on auditory representations and machine learning techniques for mapping voices between different speakers. Used LPC analysis, vocal tract modeling, and harmonic+noise coding techniques to analyze and reconstruct natural sounding speech. <http://www.media.mit.edu/~nitin/voicemap/>

STARLAB (Summer '98)  
Agents and Wearable Computing Group, Brussels, Belgium

Worked on *COMRIS*, a project funded by the I3 Esprit initiative of the European Commission. Designed a distributed agent simulation (Java) for delivery of contextually relevant information in a conference environment. Developed an interface module that synchronized agent messages (using XML) with synthetic speech and audio for a wearable device.

FUJI-XEROX PALO-ALTO RESEARCH LABORATORIES (Summer '96)  
Mobile Computing Research Group, Palo-Alto, California

Worked with a team of researchers on a dynamically organized ink and audio-based mobile notebook. Design and development of mobile audio interface using Visual C++. Awarded an **International Patent**: "System for capturing and retrieving audio data and corresponding hand-written notes", Xerox Corporation and Fuji Xerox Company, Ltd. June 1998.

GRAPHICS, VISUALIZATION AND USABILITY CENTER (1995 - 1996)  
Future Computing Environments Group, Georgia Tech, Atlanta, Georgia

Graduate research assistant working on the *Classroom 2000* project. Developed pen-based annotation software for electronic note taking and review on mobile computers and the large-scale display, the *LiveBoard*. The system captured annotations and generated web-based notes synchronized with recorded audio. <http://www.cc.gatech.edu/fce/eclass/>

MELITA INTERNATIONAL CORPORATION (1992 - 1995)  
Advanced Product Development, Norcross, Georgia

Developed software and database modules for a client-server telephony application to provide a visual interface to time zone and area code management. Responsible for requirements analysis, object-oriented design, code development, usability testing and documentation.

MICHAEL C. CARLOS MUSEUM (1993 - 1994)  
Dept. of Education, Emory University, Atlanta, Georgia

Performed technology assessment and multimedia application strategy to serve the needs of various departments of the museum. Prototyped and analyzed the use of museum educational software with students at a private school.

## ACADEMIC PUBLICATIONS

### JOURNALS

Nitin Sawhney, Saul Griffith, Yael Maguire and Timothy Prester. ThinkCycle: Sharing Distributed Design Knowledge for Open Collaborative Design. *International Journal of Technologies for the Advancement of Knowledge and Learning (TechKnowLogia)*, Volume 4 Issue 1, Jan 2002.

Nitin Sawhney, Sean Wheeler and Chris Schmandt. Aware Community Portals: Shared Information Appliances for Transitional Spaces. *Journal of Personal and Ubiquitous Computing*, 2001, Volume 5, pp. 66-70.

Nitin Sawhney and Chris Schmandt. Nomadic Radio: Speech and Audio Interaction for Contextual Messaging in Nomadic Environments. *ACM Transactions on Computer-Human Interaction (TOCHI)*, Sept. 2000, Volume 7 Issue 3. pp. 353-383.

Nitin Sawhney, David Balcom and Ian Smith. Authoring and Navigating Video in Space and Time: An Approach Towards Hypervideo. *IEEE Multimedia Journal*, Winter 1997.

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Nitin Sawhney, Timothy Prester, Yael Maguire and Saul Griffith. ThinkCycle: Supporting Open Collaboration and Sustainable Engineering Design in Education. *Development by Design, 2<sup>nd</sup> International Conference on Open Collaborative Design for Sustainable Innovation*, Bangalore, India, Dec 1-2, 2002.

Nitin Sawhney, Sean Wheeler and Chris Schmandt. Aware Community Portals: Shared Information Appliances for Transitional Spaces. *Workshop on Situated Interaction in Ubiquitous Computing, CHI 2000*, Netherlands, April 3, 2000.

Nitin Sawhney and Chris Schmandt. Nomadic Radio: Scaleable and Contextual Notification for Wearable Audio Messaging. *ACM SIGCHI Conference on Human Factors in Computing Systems*, Pittsburgh, May 15-20, 1999.

Brian Clarkson, Nitin Sawhney and Alex Pentland. Auditory Context Awareness in Wearable Computing, *Workshop on Perceptual User Interfaces*, San Francisco, Nov. 5-6, 1998.

Nitin Sawhney and Chris Schmandt. Speaking and Listening on the Run: Design for Wearable Audio Computing. *Proceedings of the International Symposium on Wearable Computing*, Pittsburgh, Pennsylvania, 19-20 October 1998.

Lynn Wilcox, Bill Schilit and Nitin Sawhney. Dynamite: A Dynamically Organized Ink and Audio Notebook. *Proceedings of CHI '97, Conference on Human Factors in Computing Systems*, March 1997.

Gregory D. Abowd, Chris Atkeson, Ami Feinstein, Cindy Hmelo, Rob Kooper, Sue Long, Nitin Sawhney and Mikiya Tani. Teaching and Learning as Multimedia Authoring: The Classroom 2000 Project. *Proceedings of the ACM Multimedia '96 Conference*, November 1996.

Nitin Sawhney and Arthur Murphy. Espace 2: An Experimental HyperAudio Environment. *Proceedings of CHI '96, Conference on Human Factors in Computing Systems*, April 1996.

Nitin Sawhney, David Balcom and Ian Smith. HyperCafe: Narrative and Aesthetic Properties of Hypervideo. *Proceedings of Hypertext '96: Seventh ACM Conference on Hypertext*. 1996. **Recipient of the First Engelbart Best Paper Award.**

## ACTIVITIES AND INTERESTS

Founder and co-organizer of the *development by design* (dyd01), an international peer-reviewed workshop on sustainable design at MIT in July 2001. Program Co-Chair for the 2<sup>nd</sup> International dyd02 Conference held in conjunction with ACM SIGCHI, ICSID, Media Lab Asia and academic institutions in Bangalore, India. <http://www.thinkcycle.org/dyd02>

Volunteered with a nonprofit organization, AID-Boston, a chapter of the Association for India's Development. Worked on developmental projects and grassroots programs with NGOs in India. Work included project evaluations, field-visits, organizing cultural events, fund-raising, and conducting seminars at MIT. <http://www.media.mit.edu/~nitin/aid/>

## REFERENCES

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