5 ROLE OF INTELLECTUAL PROPERTY RIGHTS IN OPEN COLLABORATIVE DESIGN

Intellectual property rights (IPR) play an important role in making design innovations accessible to target communities and producers in developing countries. Property rights in scientific research and academic settings have always sparked intense debate about the public vs. commercial nature of research conducted and its impact. Interestingly there are two trends increasingly at play in such settings: a push towards greater commercialization or privatization of research through formal IPR mechanisms like patents and copyrights, while there is growing support for greater openness towards academic programs and research through Open Source initiatives. There is an opportunity now to consider the novel approaches that support multiple views of IPR to spur greater innovation in critical problem domains.

In this study, I examine the social perceptions of property rights and nature of IPR policies adopted among product innovations in university settings. We consider 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.

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. 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.

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 we find them aligned within a typology of four emerging IPR patterns based on level of public disclosure and formal/informal nature of IPR desired. We consider the key characteristics and rationale for adopting each of these patterns.

Finally based on this analysis, we close by summarizing the ten key attributes and incentives for IPR in university settings. I outline several approaches and policies that can be adopted to support both formal and informal IPR for critical design innovation.

5.1 Property Rights in the Context of Scientific Research in University Settings

The role of intellectual property rights in scientific research has always been controversial with many arguing for either a “pure” and public exchange of research vs. the necessity of commercialization and patent protection to spur innovation and entrepreneurship. The trend in the last 2 decades, towards increasing number of patent filings in academia, greater availability of capital investment for research commercialization, and newly established university licensing offices would point towards a greater privatization of scientific research. Many have argued that the implicit outcome of this trend threatens to undermine the effective role of academic and scientific institutions in the “public sphere”.

However, some recent trends in the Open Source movement over the last 5-10 years also indicate a greater awareness of the potential benefits of public exchange among software components and standards (at least in the computer sciences). Novel educational initiatives such
as OpenCourseWare\(^5^0\) at MIT, boldly seek to apply such principles to public distribution of educational content as well. The ThinkCycle initiative at MIT towards open collaborative design in product innovation also emerged in this setting, having been influenced by similar thinking among its participants.

On the surface, both these trends would seem to be in opposition and often create much debate and controversy in academic settings. How does one reconcile the emergence of such diametric notions of intellectual property rights in university settings? Are there really two opposing camps to which individuals and institutions find themselves aligned closely i.e. Public/Open/Pure vs. Private/Closed/Commercial or is this distinction generally misleading in practice? How does the notion of property rights emerge in these settings and how is it negotiated to serve public or private interests, while retaining the spirit of innovation and collaboration in scientific research?

My main interest here is to better understand the underlying motivations and policies to propose a framework for IPR, which focuses on fair exchange and timely impact of scientific innovations developed in universities, particularly in developing countries and critical problem domains.

5.1.1 Key Research Objectives

- Understanding how Intellectual Property Rights (IPR) are perceived and redefined in the process of open collaborative design and field-deployment of product innovations developed in university settings.
- Proposing a framework for IPR that provides appropriate policies, incentives and mechanisms to ensure fair and timely access to scientific innovations for individuals and institutions in developing countries and critical problem domains.

5.1.2 Study Approach

I. Review of IPR in the Scientific Community: Understanding key issues, social incentives and legal frameworks, based on existing literature and discussions with the Technology Licensing Office at MIT.

II. Emerging IPR in DtM Projects: Interviews with lead members of 7 design projects conducted using ThinkCycle in the MIT Design Studio in 2001 and 2002, several of which are being commercialized or deployed in the field, while others remain in the design stage.

III. IPR in University Research: Additional interviews were conducted with several researchers in university settings who deployed their socially motivated innovations on the field, such as household water treatment, wheelchair and medical incubation technologies.

5.1.3 Property Rights in the Scientific Community: A Sociological Perspective

In a recent essay on property rights in scientific research Robert Merges [1996], at University of California School of Law, argues that the current norms (both formal and informal) as practiced by researchers, suggest a form of shared access common area with limited membership, rather than a purely restricted space or a wide-open public sphere. Merges finds that the “science is not so much given freely to the public as shared under a largely implicit code of conduct among a more or less well-identified circle of similarly situated scientists”. This revised understanding of the traditional notion of scientific openness provides a more pragmatic framework for policy directions that may better alleviate the “creeping privatization” that characterizes scientific research today.

Merges refers to critical observations made by sociologists studying the nature of the scientific community. Robert Merton [1973] describes the highly competitive nature of the scientific enterprise, regulated by a complex set of both formal and implicit norms. Four such norms assumed include: 1) Universalism: research judged independent of the personal characteristics of

\(^5^0\) http://ocw.mit.edu
the scientist, 2) **Communism**: scientific findings made available to all, and not held proprietary, 3) **Disinterestedness**: scientists pursuing truth rather than self-interest are ideally indifferent to the success of their experiments, and finally 4) **Organized Skepticism**: the scientific community should rigorously test any research results before accepting them as true.

However, these norms are recognized as ideal forms of behavior rather than actual practices. Sociologists have found many practices that clearly deviate from such norms. Warren Hagstrom [1965] points to many “proprietary practices” emerging among scientists from a fear of misappropriation their ideas. Hence, the extent to which they can establish property rights over their work alleviates some of this anticipation, allowing them to collaborate, agree to a division of labor or share publicly. Hagstrom mentions an implicit mechanism of protection that scientists use is to publish research abstracts, which allows them to “stake a claim” on research in progress. In competitive research areas, scientists don’t usually refuse to share information but simply do so selectively. Finally, formal property rights using patents apparently provide a form of absolute exclusivity, which would be inconsistent with the informal norms in the community. However, in reality within this community potentially patentable or patented results are often shared, though on a more limited basis.

Some implicit operational principles can be summarized as follows:

1. If there are higher intellectual or commercial stakes in a research project or if it is more expensive/difficult to create, researchers are less likely to share results openly.
2. Property rights are most aggressively enforced with direct competitors, however creators are more willing to share results with people in unrelated fields.
3. Scientists use implicit mechanisms like publishing abstracts or institutional recognition (such as awards or press articles) to stake claim on their research.
4. Informal property rights are generally neither shared openly nor kept proprietary; in practice findings are shared selectively or delayed long after publication.
5. Formal property rights through patents, though exclusive in nature, are usually shared informally on a limited basis.

Paradoxically, Merges finds that despite the widespread use of patents this “informal ness” of property rights among the scientific community is maintained by “relinquishing (or at least not asserting) some of the scientist’s formal rights”. Hence there is a continued practice of “costless sharing” despite patents. Much of the debate in reality does not center on the exclusivity of research but on the “terms of access” i.e. whether the restrictions imposed are in keeping with the operational norms of shared knowledge as currently practiced.

Given the existing norms in the scientific community, the debates on property rights and widespread use of patents, what motivates researchers to obtain patents on their work? One can consider a number of different factors:

* Financial gains from licensing royalties in the distant future or incentive to commercialize the research through startup ventures or product opportunities.
* A form of public recognition gained by the formal legitimacy of a patent.
* Being able to “stake a claim” to a research in progress via early patents.
* Institutional pressure to demonstrate relevance of one’s research via patents filed.
* Merges argues “the increasing (perceived) value of patents makes adherence to traditional community norms of open access implicitly more expensive”. For example to overcome the potential threat of patents filed by others in one’s own research area.
* Merges also cites a possible perspective from game theory, which would hold that individuals would abandon shared community norms in light of higher personal payoffs; here the “equilibrium strategy” would be to defect (from the norms to seek a patent).

### 5.1.4 Potential Framework for IPR in the Scientific Community

To develop a framework for dealing with IPR in the scientific community, we must examine several different potential policies and proposed mechanisms. We consider approaches that lie between absolute policies that suggest either fully proprietary protection and wide-open IPR in the public domain (including doing away with patents entirely). In light of current norms and
trends, policies that leverage important elements of both and coexist with social norms and incentives, would seem most pragmatic and effective.

1. **Experimental-use doctrine**: Merges argues for exemptions from patent infringement liability for researchers engaged in “pure research”; this could be extended to individuals or organizations engaged in testing and modifying designs for field experiments. In most cases this doctrine may already be informally practiced. However, its not clear if it is easily accessible to individuals and institutions outside of the scientific community.

2. **Multi-tiered IPR Transactions**: Currently IPR transactions are regulated either among scientists or with commercial entities. Merges points out that the informal transactions among scientists are conducted in the “shadow” of the formal transactions with commercial entities, hence unpatented IPR also comes with restrictions in many cases. He suggests that this 2-tiered configuration is only one of many possible. One possibility, in my mind is establishing a multi-tiered framework for transfer/exchange of property rights among different entities with differing terms such as: a) the scientific community in academic or public-funded sectors, b) commercial entities, c) nonprofit entities such as field organizations and medical institutions in developing countries, d) awareness and accessibility among the general public. This may be the way that most university technology licensing offices implicitly work anyhow. Clearly both formal and informal mechanisms should continue to play an important role in all such transactions. However, transactions among all these entities will continue to be conducted in the shadow of others, implicitly leading to terms or restrictions imposed which may not always be agreeable to all.

3. **Open Source**: Generally the open source approach is most effective as a process for co-development where expertise is distributed, rather than simply being a policy for dissemination of a finished product. Hence there may be compelling arguments for such cooperative development initiatives in specific problem domains, however applying the principle broadly to the output of all scientific research seems inappropriate. Yet it can be justified as a mechanism useful in specific areas such as standards, protocols, research tools, enabling technologies and such, where shared evolution of the design is crucial towards success of the research.

4. **Patent Pools**: In a review paper on patent pools, Merges [1999] writes “A patent pool is an arrangement among multiple patent holders to aggregate their patents. A typical pool makes all pooled patents available to each member of the pool. Pools also usually offer standard licensing terms to licensees who are not members of the pool. In addition, the typical patent pool allocates a portion of the licensing fees to each member according to a pre-set formula or procedure.” Historically, to protect the public good, governments have created collective rights organizations: mandating compulsory licensing of patents at established fees, creating and managing public patent pools, directly purchasing key enabling technology patents and placing them into the public domain, and even creating mergers between firms51. Private institutions or industry-led consortia have also organized private patent pools including small contract-based patent pools, large industry-wide patent pools, and technology standard-setting patent pools. Since 1856 such patent pools have been created to spur industries such as sewing machines, aircrafts, radio, MPEG and DVD standards, and in biotechnology. Most recently such patent pools are being proposed to provide access to affordable AIDs drugs in developing countries [Love2002]. I believe this is an approach worth examining more closely with regard to scientific or product design innovations for tackling critical problem domains in developing countries.

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5. Recognition through Public Awards: Merges cites historic debates on patents for pure sciences in Europe, centered on the League of Nations in the 1920’s and 30’s. Though many proposals were made, one that was eventually adopted by the government of France was a decree creating a “Medal of Scientific Research” with prizes, which took the place of so called “discovery patents”. This decree along with some legislated principles in socialist countries, were the only actual “legislative products of the scientific-discovery patent movement”. This form of public recognition potentially provides many of the perceived benefits of patents such as legitimacy, authorship and financial compensation, without necessarily imposing formal terms for restrictive usage or infringement. As we will see in one of the case studies, a prominent award at MIT may have supported one of the design teams to refrain from seeking a patent on their work. A similar approach is used to recognize grassroots innovators in the Honey Bee initiative in rural India [Gupta2000].

This represents only a few of many possible approaches, any combination of which could be used in framing novel property rights policies for research institutions and innovations in critical problem domains. We will later examine which ones appear to better support IPR access for collaborative design innovations in developing countries, based on actual case studies.

5.1.5 Institutional Perspective: Technology Licensing Office at MIT

To better understand the motivations and decisions made by students, faculty and researchers regarding their innovations in the university setting, it is instructive to examine the nature of the IPR arrangements, policies and support available (or perceived as such). For this purpose I had an informal discussion with Anne Hammersla, the associate intellectual property counsel at the MIT Technology Licensing Office (TLO) in March 2002. Anne advises the MIT community about IP and licensing policies, working on consortia agreements and dealing with conflicts of interest. The discussion centered on the guidelines and support for student innovations at MIT; several key points include:

- Inventions originating in coursework: Typically inventions developed by students in courses are exempted from MIT ownership; however graduate students doing projects related to their funded research may need to turn their IPR over to MIT. In most cases MIT may choose not to exercise its rights on student work originating in courses.

- Joint Inventorship: Any contributors to an invention may jointly file for a patent at MIT. In the case of faculty, researchers and graduate students, the institution (MIT) usually has ownership over patent rights as the work is conducted under agreements signed as employees of MIT. However, work done by undergraduate students is usually exempted from MIT ownership (unless it is done under sponsored research). Hence, undergraduates may file for independent patents on their own or choose to assign their rights to the institute, which would file patents on their behalf, undertaking the financial costs and providing royalties from future revenues. In cases where an invention is jointly developed by a mix of graduate and undergraduate students, and/or external participants (outside the institute), the patent rights are distributed among several joint owners e.g. the graduate students/faculty would be collectively assigned as one joint owner, while the undergraduate student or external participants would be assigned as 2nd joint owners. Each joint owner has the right to exercise their IPR independently i.e. commercialize, transfer IPR or handle revenues as needed; one joint owner (group) cannot block another, although individual members of a joint ownership must have mutual agreement.

- Exclusive Licensing Rights: Companies may be interested in gaining exclusive rights to manufacture a device (usually when the market is small and development costs are high). Here companies may wish to have both joint owners provide such rights to them or know how the other joint owners are making the IPR available to other companies that may compete with them in the future. One question is whether any company in the industrial or developing countries would choose to manufacture devices if it were not granted exclusive rights?
Patenting vs. Licensing: IPR developed at the institution may be patented and/or licensed. It is not necessary to patent an innovation (though it seems to be the trend), before licensing it for commercial production (though some licensees may expect a patent for protection). Despite obtaining a patent, the joint owners of the patent may choose to establish varying licensing arrangements for making their IPR accessible to others. Hence, joint owners may decide to impose fees and restrictions for commercial production of a device, while providing a royalty-free arrangement for nonprofit use and so on. Thus inventors have great leverage in the licensing of IPR, even relinquishing some formal rights and claims if they choose to do so under certain circumstances.

Follow-up interviews with the TLO, based on specific cases at MIT (particularly from the DtM Design Studio) would yield greater clarification and assessment of the IPR issues involved.

5.2 Study of Intellectual Property Rights in Collaborative Design

With this background as a basic context, we can now consider how property rights are perceived and redefined in the process of design innovations in university settings, intended for field deployment. We have considered the formal institutional IPR mechanisms in place at MIT. We now closely examine 7 student design projects, and later several university-based research projects where property rights were defined or negotiated in different ways.

5.2.1 Research Questions for this Study

Key questions to examine closely include: (many others emerged as the study progressed)

1. What motivated team members to work on their chosen design projects?
2. What were their prior experiences and biases towards collaborative or open projects?
3. To what extent were the projects setup as open or closed by the innovators? Why?
4. To what extent were the projects perceived as open or closed by the others? What form of access was made available to people outside the primary design team?
5. What formal and informal mechanisms for exchanging or disseminating property rights were used?
6. How did external contributions or peer review change critical design decisions? What mechanisms or incentives facilitated such contributions?
7. Under what conditions did particular teams decide to patent, license or ignore formal IP mechanisms? What key factors influenced their decisions? How did their view change over the course of the project?
8. How did their IPR approach enable them to better leverage resources for desired outcomes?

5.2.2 Projects selected from the MIT Design Studio

To better understand approaches towards IPR in design projects, I examine several case studies where innovators made decisions to take their prototypes to the field, patent or license them, or setup companies to bring products to market. In the Design that Matters studio course taught at MIT in 2001\(^{52}\) and 2002\(^{53}\), there were several projects undertaken each year. For the purposes of this study, 7 projects were studied more closely i.e. ones which proceeded beyond the design stage, making the IPR issues more critical for the innovators. These projects demonstrate a range of attitudes exhibited by innovators. The analysis provides a framework for the nature of IPR patterns that emerged and how sociological notions of IPR were redefined in the process. In the analysis, I also take into account 3-4 interviews conducted with university researchers, whose projects were deployed on the field or patented and commercialized. The IPR issues emerging in these interviews (not documented here) provide additional evidence towards rationale for the attitudes adopted among students developing design projects in sustainable technology.

\(^{52}\) http://www.media.mit.edu/~nitin/thinkcycle
\(^{53}\) http://www.thinkcycle.org/dtm
Projects from Design that Matters Studio 2001

1. **Cholera Treatment Devices:** This project was initiated by an inter-disciplinary design team consisting of three MIT engineering students, working closely with local domain experts. The key design challenge was to develop a novel low-cost IV drip flow control device that would facilitate rapid treatment of patients infected with cholera. All the concept sketches, detailed design specifications, prototype CAD models and images were archived on ThinkCycle with annotated comments. Designs that showed most promise included a modified roller clamp and a rotameter (an instrument for measuring fluid flow rates); these were more extensively refined and tested, while additional documentation regarding their design rationale and advantages/limitations was archived online on a separate website54 designed by the team. Critical feedback from two doctors at the Massachusetts General Hospital helped the team recognize real world constraints for practitioners and narrow their designs accordingly. In March of 2002, the team was contacted by representatives from healthcare company in Florida, to license their innovations for production. The team is working closely with the MIT Technology Licensing Office to obtain three patents on their innovations before pressing further.

   *Status*: Successfully prototyped; currently in process of patenting and licensing. All designs and rationale thoroughly documented on ThinkCycle with full public access.

2. **Low-Cost Eyewear:** This project also emerged from the DtM 2001 studio based on the interest of one of the instructors, Saul Griffith and speakers who discussed challenges in low cost eyewear. The innovator met with students at the Harvard Business School, who were also looking for suitable technologies and business models for delivering low cost prescriptive eyewear. Over the course of the year the original innovator developed a low cost eyeglass-manufacturing device and teamed up with two others in a precision engineering course to develop a hand-held prescription measurement device. For various reasons, few details from the project were posted on ThinkCycle; hence much of the designs remained proprietary. The team has now initiated a for-profit startup venture55, based in Washington D.C. to commercialize the technology in the developing world.

   *Status*: Successfully prototyped and patented, and in the process of commercialization through a startup company. No design plans or rationale documented on ThinkCycle. However some designs were documented on separate private website.

3. **Hand-Power Generator:** The goal of the project was to design a device capable of generating up to 5W of power and storing it conveniently and at low weight and cost for later use. The power would be made available at an appropriate range of voltages to drive a generic array of electronics devices. With more than 3 billion single use batteries going to waste in the US alone each year, such a device could also be very useful environmentally. The design concept was based on the “bull-roarer”, an indigenous instrument that utilizes the swinging of a weighted flat piece of wood at the end of a piece of string to generate low frequency sound. The swinging input mechanism is extremely efficient in terms of coupling human power to rotary motion. The prototyped developed used this mechanism for charging a set of rechargeable batteries or a super capacitor. All design models and electronic schematics were posted on ThinkCycle.

   *Status*: Successfully prototyped and patented, but not licensed or commercialized. All design files archived on ThinkCycle, while the visual design process56 and design CAD models57 were documented elsewhere online for public access.

54 http://www.mit.edu/~tprester/DtM/
55 http://www.lowcosteyeglasses.net/
56 http://web.media.mit.edu/~saul/thinkcycle/webtst/
57 http://web.media.mit.edu/~saul/bettery/
4. **Passive Incubator for Premature Infants**: The project aimed to design a passive incubator for premature infants. Every year, 4 million infants die within their first 28 days of life, with 3.9 million in the developing world. 25% of these deaths are due to the complications in prematurity, usually simple heat loss and dehydration. The lack of electricity in rural areas and frequent loss of power in urban regions renders a high-tech incubator worthless in these settings. In collaboration with Doctors Without Borders, the Brigham and Women's Hospital in Boston and faculty at MIT, the team developed a prototype for a low cost passive incubator, that will run independent of electricity. The team is currently in the process of testing the device followed by deployment in the field. The target users are rural clinics in Sri Lanka. On May 9, 2002, this team received the Lemelson international technology award at MIT.\(^{58}\)

*Status*: Successfully prototyped and currently being field-tested. Design rationale and plans partially documented on ThinkCycle with private access.

5. **Low-Cost Library using Portable Optical Reading Devices**: In this project the goal was to develop an inexpensive microfilm storage device and reader to improve access to books in developing countries. Information is stored on microfilm rolls that would be housed in ordinary cassette tapes. The microfilm would contain 4mm x 3mm images that could then be magnified using simple optics and either viewed by a single user, or projected. An individual can use a binocular device held up to the eyes to view the information while a separate tool could be designed to display the image on a screen for multi-person viewing. The microfilm reader is battery powered, using a Light Emitting Diode (LED) as the light source for illumination. A single microfilm cassette can hold about 90,000 pages of text or graphics.

*Status*: Partially prototyped. Design rationale documented (but not the design files).

6. **Smart-Canes for the Visually Impaired**: The visually impaired need intuitive and natural mobility aids, however most technology development in this area does not provide affordable solutions for all. This project was a culmination of research on prior art, fieldwork at the Canadian National Institute for the Blind, and rapid prototyping at the MIT Media Lab. An early prototype of a "smart" cane uses optical sensors and the blue dot cricket (as a signal processing circuit). The prototype is an adaptation of a standard cane, which functions as an electronic proximity detector, and relays distance information to the user by way of distance-dependant tactile (vibrational) feedback. Preliminary testing with a visually impaired subject showed encouraging results.

*Status*: Successfully prototyped and prelim testing. Designs partly documented on ThinkCycle with private access only (design files only, no rationale).

7. **Bio-sand Water Filters in Nicaragua**: In the aftermath of the 1998 hurricane Mitch in Nicaragua, thousands of bio-sand filters were distributed throughout the country to provide safe drinking water to the population. Even though these filters have been very successful in other parts of the world (e.g. Nepal), their performance in Nicaragua has not been as impressive. The goal of this project was to investigate why the bio-sand filter has not been as successful in Nicaragua and to improve the design to overcome this limitation. Improvements in the design cover not only hardware, but also use (operation, maintenance) and education of the end-users.

*Status*: Successfully prototyped and tested. The project requirements and design resources were documented on ThinkCycle, with public access.

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58 [http://www.mit.edu/~ideas/winners.html](http://www.mit.edu/~ideas/winners.html)
5.2.3 Methodology and Interview Questions

Of the dozen or so projects from the MIT studio courses, the 7 projects selected here for the study have reached a sufficient level of progress or closure, that made the notion of IPR issues relevant to the participants. Intensive interviews were conducted with 10 lead informants who participated in these projects. Each interview lasted approximately 90 minutes, and was tape-recorded. Every interview was subsequently summarized and all conversations regarding IPR issues were painstakingly transcribed, to enable an ethnographic analysis of the informant’s perceptions of intellectual property rights.

The following questions were posed to informants in the study. The interviews were conducted in an unstructured manner, and these questions primarily served as a means to engage the informants in a conversation, hence many questions were improvised based on prior responses.

Q1. Why did you join this studio? What did you expect to gain?
Q2. Why did you decide to work on this design project?
Q3. How was the team formed and whom did you consult in the process?
Q4. Describe to me how the problem constraints and design concepts evolved? Draw a timeline and show me the significant decisions your team made? Show me working sketches?
Q5. How did your team work together and communicate during the process? How did you resolve and negotiate key decisions?
Q6. How did other organizations and domain experts help in the design process? What do you think motivated them to get involved? What was their key contribution?
Q7. When did you use ThinkCycle in the process? Why did you find it helpful or not? What online tools would have supported your design process better?
Q8. In your previous projects, did you work in teams and what were some of the best outcomes? Did your prior projects get published or patented?
Q9. Did you feel comfortable discussing your project with others outside class? How did you solicit external review of the project? What prevented you from disclosing it more publicly?
Q10. Do you plan to continue working on this project? Will you field-test, license or patent it? Why or why not? If a company approached you about it, what would you do?
Q11. How do you think the project would have the most impact – through full public disclosure (open source) or proprietary licensing? Which do you think makes most sense in your project and why? What do you think about “open source” having gone through this project?
Q12. What are your long-term career plans? Where do you see yourself in 5 years? Do you see yourself playing a role in addressing social or environmental problems? How do you feel you can have the most impact?

In this analysis we will primarily focus on the IPR issues emerging from these interviews, while aspects of cooperative design and learning will be examined in more detail in other sections of the thesis (however they inform the IPR aspects discussed here).

5.3 Perceptions of Intellectual Property Rights in Collaborative Design

In this preliminary analysis we first consider some of the meanings, attitudes and perceptions that shape the informants views of intellectual property rights, and their subsequent approach towards their own design innovations. We will also seek to understand if and how these notions of IPR were redefined during the course of the studio design projects. Hence, I will draw upon and categorize spoken dialogues from transcribed conversations with informants.

General Perceptions: Patents vs. Open Source

Presence of Reasoned IPR Rationale despite Confusion and Uncertainty

The over-arching observation that one can make from interviews suggests a great deal of confusion and uncertainty about formal IPR such as patents, Open Source, licensing etc and particularly in the differences in tradeoffs and outcomes of these approaches. Most of the
informants do not have a clear or informed view of these issues. At first glance much of their thinking around IPR issues may seem simplistic or dichotomous, however when pressed with decisive scenarios and additional information, they provide surprisingly well-reasoned rationale for taking specific IPR approaches. Despite some ambiguity about the approaches, informants tend to argue strongly for (and against) patenting, copyrighting, licensing or Open Source. Some of the rationale begins to break down at the boundary conditions around Formal IPR and Public Good. At this junction there is much debate and evolving notions about appropriate approaches.

When pressed about formal IP approaches, informants attribute a diverse set of concrete notions to patents where as their notions around Open Source tend to be less articulate and more ambiguous. This suggests a greater exposure and perceived legitimacy attributed to patenting (both positive and negative attitudes) whereas Open Source is often treated like an experiment, fad or academic exercise. Overall patenting is considered a more useful and operational mechanism (despite being inappropriate in many cases), while the notion of Open Source is considered premature, “tricky” or unrealistic in real-world situations for a variety of reasons.

5.3.1 Diverse and Reasoned Notions about Patents

Patent as Recognition and Privilege: The most often cited attribute of patenting tends to be the level of social recognition and privilege associated with it. Almost all informants view receiving a patent as a positive and legitimate form of property right, akin to an “award”. This stature associated with patents is key motivation for engineers (not necessarily researchers in the basic sciences), particularly ones who have not filed for patents in the past. It is often considered helpful in resumes and to get one’s “foot in the door” when applying for jobs or talking to organizations. This suggests that any proposed alternatives to patents must provide a similar form of legitimate recognition as an important incentive for adoption.

“I’m not sure I can give that intelligent of an answer, but … I think it would be cool to patent it because, this is really stupid, I’ve always wanted a patent, its cool to get a patent in college."

“… well I didn’t know anything about patents, even the possibility of having my name on a patent was just exciting. I never thought… well how many undergraduates from MIT would ever have a patent filed, even an application as an undergraduate. I would say its very few, very small percentage. So that was like a privilege.”

“… well it’s kinda like a sense of accomplishment I guess for yourself. Umm… you know it’s a pretty big deal to do something like that.”

“I don’t think it (monetary benefit) was a large part, it was probably more that we can have “recognition” – that was probably more of a motivation.”

Patent as Real-World Learning: Some informants viewed familiarity with the patent-process as an important facet of learning about product development in the real world (presumably outside university settings). Some feel it is a “natural part of designing products” and hence the exposure is helpful.

“And so it was another means of… And from an individual perspective it’s also a chance to become familiar with something that’s a natural part of designing products within the commercial setting. So the process of learning about patents and licensing is another experience.”

“Plus, in terms of the education, I think it’s important that people at least have an exposure to the processes that surround design, and designing products and designing ideas. For people working in an ideal environment like academia, that’s another aspect of training. You have to get exposure to that at some point.”

One might argue that various aspects of patenting such as prior art search and documentation are a part of academic rigor (and could be reinforced in coursework and publications), however
these aspects are clearly motivated by patent filing. The nature of conflicts and negotiations arising in the process of patenting and licensing can be considered a unique form of learning, not usually available in academic settings but is it the role of an academic enterprise?

Patent as Publication: In many cases a patent is referred to in terms of publications not unlike a journal article, given the nature of rigorous documentation and detailed drawings required. The fact that it is evaluated by “experts” and made accessible in a public database gives it the role of a legitimate publication. However, it is unclear as to whether informants consider the intellectual property in the public domain when it is patented.

“Another part of it was that it’s also a form of publication, so you can have a more rigorous documentation of your idea in the public domain.”

An example of a patent perceived as public domain knowledge:

“Q: What happens after that one year to the public-ness of that project? If you patent it does it still remain in the public domain or not?

No if you patent it then… by definition patenting is putting it into the public domain, but then people have to license it from you. So you know, everyone can still access the ideas and they can make that thing for their own personal use, but they can’t profit from that thing.”

An example of why patent was not considered in the public domain:

“(I did not feel strongly about patenting) because first of all I felt slightly conflicted because I did want this to be in the public domain such that people could, you know if they wanted to use it.”

Patent as Preemptive Protection: There is concern that one needs to overcome a potential threat posed by others patenting the designs to avoid infringement. Hence a fear of infringement claims may lead to a perceived need for preemptive patent protection. Patenting is recognized as a protective mechanism providing legal cover for one’s intellectual property. Alternative mechanisms proposed should ensure a form of legitimate protective cover.

“So that (Open Source) actually can be pretty dangerous, because then anyone can just kinda take your idea, patent it and then they can do whatever they want with your invention. And then if you develop your idea and its socially responsible – its also problematic in that of you try to patent it and you can infringe on their patent.”

“It seems like patents are a good way to kind of inspire people to work on something … so like if there were no such thing as a patent, then anyone could just take anyone else’s idea but its just kind of the way people work, you know…. I think that having a system like that in place probably has fueled some innovation over the years.”

Patent as Control: The most overwhelming rationale for patenting is attributed to having some level of “control” over how the intellectual property is utilized by others. This notion of control takes the form of 1) Appropriate Usage: ensuring the design solves the intended problem and target users or the idea does not get “exploited” i.e. used for the wrong purpose, 2) Manufacturing Quality: ensuring the device is manufactured in accordance with the design constraints and safety standards, 3) Leverage to Negotiate or Intervene: (perceived) ability to intervene in the production of the design when needed or negotiate how it will be used, 4) Commercialization: ability to commercialize the technology i.e. “raise that money and to get people to bank on your technology and assist you in the project”.

“Umm, our motivation for pursuing a patent was a combination of having some element of control of where the idea would go. We worked on project with very idealistic goals in wanting to see the original (health) application as being possible with the new device. So that was a concern, so by patent you have some say over what happens to that.”
"I just, I would just want proprietary licensing to be able to make sure like our idea doesn’t get exploited or like people don’t make it wrong. Or if we have suggestions for it and if we don’t like what some other company does to it, then we have some control over that. Umm, I guess I don’t know … it would save lives of premature infants. But I’d be sacred like, it’s such a big thing… I don’t know I’m just scared something would go wrong and it would kill a baby and we’d get into trouble.”

“So, umm… then I was reading up on the fact that unless you actually have a patent on an idea its hard to control whether the idea is used appropriately by socially responsible people. So I decide to make it Private so I could control that.

Q: Control what exactly?

How… control that the people that would develop the idea would actually keep in mind the visually impaired people and their needs and not just develop a copy-cat product.”

“… but the other way to look at it (patents) is that you’re really covering bases in that you can control the idea, and you’re getting credit for it. For example, if an idea isn’t patent by the inventor then if the idea is taken by some company and used for some completely offline use you never thought of, then you have no course of intervention. No say in it. But if you had intellectual property protection covered on those designs then it gives you flexibility on how you’d like to see that happen.”

“I think that if you patent it, you could… its your patent but it doesn’t mean that you… restrict the use of it. So maybe you can patent it and give reuse for people who want to use it. Because in some last resort where you think maybe some people shouldn’t use it or shouldn’t take… say you leave your design open and everybody can use it and you see that some people are using it incorrectly, to what you think is incorrectly. Maybe if you have the patent then you have some leverage to negotiate with that.”

“In some cases the patents add value, it gives you a huge degree of control over the project and its implementation. And particularly on those projects with a… you know pragmatically it requires money to implement it realistically. In those cases where you require a significant amount (of funding), you require a lot more control over your intellectual property to raise that money and to get people to bank on your technology and assist you in the project.”

One must recognize the role of “control” as a critical aspect for patenting in the mind of innovators, not simply as a means for monetary reward but as one to ensure the appropriate usage and manufacturability of the device. However, it can be argued that it is not the patent itself but the nature of licensing that enables one to negotiate such terms.

**Patent as Commercial Enabler:** There is a notion that patenting provides a commercial incentive to bring the innovation to market, by allowing companies exclusive rights for manufacturing the technology and recoup production costs. The idea of formalizing one’s intellectual property (via patents) ensured that there would be greater commercial interest. However it is not clear whether exclusivity is necessary or that even patenting is necessary for licensing an innovation to different manufacturers. Many competing products are indeed produced in the marketplace and differentiated by packaging, quality, target usage, cost and other attributes. There is some contention that exclusive rights may also be required in developing countries, however other informants suggested that had not prevented manufacturers in the past from seeking to produce similar products.

“The thing is no one is going to manufacture a device unless they can have some advantage in the market. And the only way to have advantage in the market is to have exclusive access to an idea. So the patent is almost an enabler for commercial production.”

“We definitely thought it as being the right thing to do, because otherwise we didn’t see anything happening with the project. We thought of it as way of guaranteeing that something happened with our design.

…

It just sounded like it was exciting because somebody was interested in continuing with the project and definitely the idea of it being made into a product was, for us, the best result.”
**Patent as Non-monetary:** Most informants indicated that monetary concerns were not a driving motivation for obtaining a patent; they recognized that they would receive minimal royalties, if any. However others also indicated that the technology was usually in an area, which was not their main “profession”. Most had not intended to pursue it seriously in the future, and hence were not relying on potential patent revenues for their livelihood.

“The whole aspect of royalties and license fees – it’s almost peripheral. It’s such a simple device that’s made easily, that we’re not talking about huge dollars here.”

“Oh, it wasn’t the monetary. We did a calculation, just for fun and even if they sold millions of these, we would get so little, it’s not an issue.”

“I’m just not one to be about all that concerned about money, and two I don’t think that this is like my main occupation or anything. I’m sure I’ll be able to get a job and I’ll have a good amount of money to live on. But I think it’d be kinda nice to get recognition for it…”

**Patent as Unethical:** Some informants remarked about the negative connotations associated with patents with respect to monetary rewards. This connotation did not prevent them from patenting, but it did make them somewhat hesitant in the context of the social motivations behind the studio course. One respondent described the process of patenting as “swimming with the sharks” i.e. influenced strongly by commercial interests, which had made her hesitant to patent her work in the studio course.

“With patenting it’s very easy to see it as just a way of earning income, so it’s perceived as being money making…”

“Ok, let me say it this way, when I think of “patent” I think of “profit” and when I think of this class I think of completely the opposite.”

“I’m very reluctant about the 2 patents I’m going to get, in terms of the process just because we are swimming with the sharks.”

**Patents as Mystifying:** Most young innovators in university settings are unfamiliar with the patent process and its implications. Once initiated, it can be an overwhelming process. Despite having gone through the process, many informants were still unclear and confused about many aspects of it. However having a trusted intermediary taking care of the process apparently alleviates such concerns and provides a lower threshold to enter the “patent game”, particularly as the filing costs are undertaken by the intermediary and perceived risks are low.

“And then it was more involving because I was getting mailing like crazy. Every 2 days I would get 3 really thick files with information, with forms that I had to sign and etc, etc, etc… from the Technology Licensing Office here. And lot of emails where you had to cc many many people every time…and to be honest I still don’t understand fully how this process works. I know… I mean they explained to me the general steps but umm… I’m not sure what is best to do or what we are waiting for now. So it’s a little confusing. But they take care of everything, if you do it through MIT there’s nothing you have to do except for signing forms.”

Conversely, a similar level of mystique may be associated with Open Source, however the process of placing one’s innovation in the Open Source mechanism is not easily facilitated by trusted intermediaries. An interesting question to consider is whether the Technology Licensing Office or another intermediary (perhaps a nonprofit legal entity) provided innovators both options and facilitated either one on their behalf, would this change the incentives to patent by default?

**5.3.2 Simplified and Cautious Notions about Open Source**

In conversing with informants, in general there is less articulation about their perceptions of Open Source and a lack of the systematic rationale seen in discussions about patents. Most informants...
view it as a “noble” idea or academic approach but few regard it as a feasible operational concept for taking serious innovations out to market. Some of this perception may be attributed to a lack of prior exposure and working examples of Open Source innovations in the context of hardware. However, it is also clear that unless some of the attributes and outcomes associated with patenting such as recognition, control, publication and protection are addressed, few innovators would consider alternatives to patents if they wish to formalize IPR. Finally Open Source requires a notion of reciprocity such as cooperative development, the lack of which makes this approach less appealing.

Open Source as Noble: There is a negative perception associated with Open Source as being entirely altruistic or “noble”, which would not ensure attributes such as recognition, control etc. This perception makes it seem less likely as a feasible operational approach.

“It seems really noble. It goes along with the spirit of helping people, being good. I could see in some ways I wouldn’t be happy with it. I’m not sure, like I really like getting recognition for things I do.”

Open Source as Fad: A few informants exhibited skepticism about the idea of Open Source, particularly as it was regularly hyped in the media – so it seemed more like a fad. Clearly much of the extraneous publicity around Open Source changes its perception as a serious academic or commercial mechanism in their minds; this connotation of a fad might distance some from openly embracing the concept for their own intellectual property.

“To be honest when I started the class it sounded kinda hoacky. Umm… just because Open Source was like the new… whatever, it was just the, everybody was talking about Open Source everything and I think it was getting, I mean its kind of like Sustainability is now. Everybody is talking about sustainable everything, sustainable breakfast cereal. Umm, I mean there is Open Source food (referring to the OpenCola beverage).”

This pattern may parallel that seen in the software community when premature notions of “Free Software” (pioneered by Richard Stallman) first emerged; it wasn’t until it was operationalized under a commercially viable concept of “Open Source” (by a group of mainstream software developers including Eric Raymond) which was adopted by some companies did the concept receive legitimacy in the public eye. Hence without sufficient examples and legitimacy, the notion of Open Source in hardware seems to be at this stage of perception.

Open Source in Software vs. Hardware: Some informants suggested that the hardware innovations require capital investment for manufacturing and distribution, which makes it difficult to adopt an Open Source approach here unlike software. However it can be argued that similar investment is often necessary in the software industry, and many protective mechanisms like copyrights have been used in the past. As we will consider later, the hardware/software distinction may be less important than that of the scale of production/distribution costs involved.

“I think that there are good applications for it, I think that hardware is very different from software, umm… like fundamentally different from software. So, I … I don’t know, you know I’m still on the fence regarding Open Source as a means for developing hardware.”

Open Source as Cooperative Process vs. Public Contribution: There is a clear tension between the notion of Open Source as a cooperative endeavor with multiple contributors vs. simply one of freely disseminating intellectual property. This lack of perceived reciprocity pushed at least one informant to go “Closed Source” when others did not seem to be contributing to his project online. But it was probably not the main reason, as another informant chose to keep his work open, despite lack of peer contributions.

“Umm… well Open Source is actually tricky, because Open Source can mean so many things. In one sense it can mean you share with people that are contributing to your project, for example if companies were going to do joint ventures. And to other people Open Source means it’s completely open to the entire public.”
"I would say that I would have wanted to contribute collaboratively with people but it really didn’t end up working out so I decided to keep it private. If lots of people in the community or elsewhere decided to contribute I probably would have kept it Open Source. Because once again, I was more interested in stimulating interest."

Open Source as an Academic Exercise: Informants in the context of the studio course, naturally treated their projects as pedagogical rather than real-world ventures. The institutional setting and lack of external stakeholders reinforced that mindset. Hence, the IPR approach in the early stages also reflected this academic nature, i.e. treating it as Open Source by default. However as the projects seemed more commercially viable (“a real solution”) some informants did not continue to maintain an Open Source mindset, seeking patents instead.

"...it (the project) was Open Source in that, in doing the project I don’t think any of us had really consider that this would become a Device. We were all pretty skeptical in the beginning in the potential of the course to really solve the problem. My interest was... the reason I liked the course was that it was exposing students to the problems. So I don’t think any of us seriously considered that this thing would ever get built. Umm... so it did feel like very much an academic exercise. So publishing our designs, that was a continuation, at least in my opinion, of an academic exercise that some other students could continue and kind of chip away at the problem. Umm... just because it had a lot of elements for an academic exercise. Umm... but I never... certainly at the beginning of the class we didn’t consider this as being kind of a route to a real solution and even now I’m not sure what else needs to happen to make it a real solution."

In summary, it seems that Open Source is still generally associated with academic experiments rather serious commercialization. To promote adoption of Open Source as a serious mechanism for product development, there needs to be a few good examples of projects having taken this route to market.

Does the discussion of Open Source vs. patenting in an academic setting introduce formal notions of IPR into the design process? This would prove to be an ironic and unintended outcome of pushing the Open Source approach in studio design courses. One informant argues that there is a danger that introducing such notions places a burden on students to grapple with difficult IPR issues and may induce them to be more protective of their work.

"The only problem with Open Source is that it introduces the student with this idea that they could make money from it or somebody else could make money from it, or that there’s a risk that the design could be used or taken away from them."

"So, I think if I was to do the project again I like the idea that... I like the fact that in the beginning we weren’t even told about patenting or Open Source or any of that stuff. But it was just “work on the design”. I think that 90% of the time it’s a non-issue, its not even going to come up, patenting. Just because it is very difficult to come up with a truly innovative design. And, so I think that putting this heavy load in the beginning on, you know, intellectual property and all this stuff could be misleading to students. Umm... because it makes them think that they are automatically going to arrive at some sort of intellectual property.

... So it just makes them suspicious, less interested in communication and in the early stages of the product when its crucial that they brainstorm and share ideas and ask questions, not feeling constrained in any way. And I think that the whole Open Source vs. Patenting debate becomes an impediment to a good design."

Though a pattern of protective behavior was clearly not exhibited by all informants, it still seems to be a valid issue to consider while introducing IPR aspects in design courses.
5.3.3 Factors Influencing Changes in the IPR Approach: Biases and Conflicts

The interviews point to at least four areas of conflicting factors, affordances or biases that emerge in the process of development. These influence the manner in which IPR is perceived and the nature of approaches adopted. These are summarized here:

- Perceived Scale or Impact of Innovation
- Scope of IPR in terms of Deferred or Territorial Enforcement
- Institutional Bias and Stakes in the Project
- Formal and Informal Social Contracts that Moderate IP

A. Notions of Scale: Being “Under the Radar” or “Sub-Threshold”

Informants often suggested the “scale” of development or impact of the innovation influenced their approach towards the IPR. For example, they would not consider formal IPR like patenting or licensing for small-scale projects that were directed to a specific community, while such notions would play a role for larger projects, particularly when interfacing with government or commercial entities.

“You know when you’re working with Development Issues, when you’re working with a rural village that hasn’t heard of a TV, I don’t think all these licensing things work. Honestly, I mean they wouldn’t be very effective. Now on a bigger scale when you’re talking about governmental hospitals, yes it would.”

“I don’t think you should locally optimize things, like I don’t feel like that kind of market would have been worth like hundreds of millions of dollars, might have been worth a few million dollars and unless you think its something that is really, really big and is really going to change the world, umm… then I don’t think its really important to do patent protection on those kind of things.”

A notion of scale was also invoked with respect to the quality of outcomes of the innovation. Commercializing and engineering the innovation on such a scale required a “non-trivial expense” which changed their IPR approach.

“Q: So what changed (for you to switch from Open Source to patenting)? Did you find that…

I guess realizing that we were making better than first quality lenses. And then realizing the expenses required to get that particular device built on the scale required to implement and make a real difference. And that engineering is certainly a non-trivial expense.”

Finally, informants often described scale by referring to innovations being “under the radar” of commercial interest. These “sub-threshold” projects were characterized as ones that would not be profitable if commercialized for the target users or have “self-supporting markets”. Such innovations were considered best to be made available for nonprofit manufacture or distribution under Open Source licensing. Interestingly, one informant here points out that it is not always possible to know whether a project is “sub-threshold” or not; indeed many innovations when further developed emerge above the “radar” of commercialization (in the minds of the innovators as the technology seems promising when solicited by companies).

“Idealistically I think it has a lot of potential, in terms of working on problems of this nature where they don’t have a lot of… they’re sort of under the radar than things of more commercial interest.”

“So for any large scale project you need to raise the money to do that, and IP is critical in most cases. Now there are a whole bunch of sub-threshold projects which will never be profitable which need to be done in the way that they should be open domain. Things like that are the baby humidifier, no patent would ever justify its expense in that domain. Umm… and you know I think there’s a very large number of projects that are like that, things that should exist but are not self supporting markets.

You don’t always know in advance what the sub-threshold versus the non-sub-threshold project is. In some respects I thought that (my design innovation) may have been sub-threshold.”
“Q: So tell me when you put something public and when you didn’t - when you made a decision to be a bit more low profile about it.

Ummm… upon realizing the potential of some of the (manufacturing) processes, and (recognizing) the fact that the way to fund the whole project might be to sell that IP and that IP – realizing that it had a high value potentially, meant that it was unwise, if we are going to pursue this to negate our access to… [garble] publishing or not.”

B. Scope of IPR influences Formal Assertion

The informants consistently suggested that the scope of IPR in terms of its temporal and territorial validity influenced their decision to seek formal IPR, particularly with respect to maintaining access in developing countries. Let’s consider the rationale for both aspects here.

Deferred Assertion of Patents: All informants who considered filing for patents, pointed out that the one-year period after publicly disclosing their ideas, enabled them to defer the decision to patent (only valid in the US) and in many cases leave the designs publicly accessible during that period (and after). In 2 cases though, informants chose to keep the designs private for reasons we will consider later. This one-year rule seems to be a critical juncture for decisions regarding the “sub-threshold” question, the patentability of the idea and a rush to get the designs to a stage where patentability can be resolved. Without the one-year buffer, as practiced in European patent law, it is likely that innovators would either file for patents immediately, keep designs private or make a decision to leave designs publicly accessible from the onset (in effect relinquishing their right to patent).

“I think the nice solution is this one year – you can work on a project for a year and then you haven’t negated your capacity to … I think that one year in nearly all cases is enough time to determine sort of the sub-threshold question, if you like. And then you don’t negate your opportunity in applying for a patent, which in some projects is probably more optimal in terms of seeing their realization, and in others that would be its detriment. So you get that one-year to analyze it… think about it.”

“We were fortunate in that if they (the company) had contacted us two months later it would have been a mute issues, because we had only a year after public disclosure to actually patent our designs or to apply for a patent.”

“I wanted to work on getting a patent because you have a year from the time you make the patent public, I mean the idea public, so that’s actually coming up.”

Territorial Scope of Patents: A key factor influencing informants to patent their innovations, while seeking to maintain access in developing countries was the notion that the patent would only be enforced in the US, i.e. individuals and companies in developing countries could always manufacture it without any legal recourse. This territorial scope enabled innovators to retain the intended spirit and impact of the innovation, while allowing commercial production in the US. However, there was also a recognition that the products manufactured in developing countries could not be exported to the US, and that in some cases companies in the developing countries may seek exclusive manufacturing rights as well (though another informant later pointed out that this had not stopped companies in the past).

“We made it very clear in our discussions with TLO that our motivation was to have this available in developing countries and through our discussions with them and realizing that internationally the idea’s out there anyway. So the motivation to where it was freely available as an idea internationally. And so within the US it may be protected but internationally people can do whatever.”

…I’m not sure where they negotiations are. But it’s really a question of US market at this point. Cause anyone internationally can make it … they couldn’t import them to the US, so that’s a factor as well.”

“And I know that the patent process is, in a worldwide, in a global sense quite complicated and simple in the sense that its possible to protect locally but not globally, such that you can, you know, make money off a product made in this country and still provide people with access in developing countries.”
“Originally we were excited because, because we had disclosed the technology prior to applying for a patent, it meant that it was unpatentable anywhere else in the world. So our patent will only apply in the United States, and this design cannot be patented outside of the United States. And we thought that it was the perfect solution; because that meant that an American company could develop this technology but a company, say in West Africa or India, could pick up the design without having to pay any royalties.”

“so we kept on having discussions and what came out was that, in the US it would actually be commercially applicable, so if someone were to use this patent they had to pay royalties to MIT and that would increase the cost of the product etc. But if the technology or the idea was used in an international setting, lets say in India or Argentina then there was no issue with MIT. I think that pretty much settled all the concerns we had, because we know that it could be used in developing countries and there would not be any financial issues to deter these countries to use it.”

Hence the temporal and territorial scope of patents in the US provides a useful solution to the question of public access in developing countries.

C. Institutional Bias and Stakes in the Project

In the interviews it was clear that institutional factors including stakes and biases play an important role in the notions of IPR emerging among innovators. Three such factors include: 1) Academic setting influences ongoing stake in the design and the ethics of patenting, 2) Culture of Innovation at MIT and Presence of TLO influences assertion of patents, 3) Collaboration with external entities or having a nonprofit entity administering the IPR.

Role of Academic Setting: Clearly most informants were primarily influenced by the social motivation in the course and the academic setting with respect to the IPR for their innovation. In addition, the change in level of venture funding at the time also influenced their approach. However later we consider examples where, despite the social and academic context, informants considered formal IPR approaches appropriate for a number of reasons.

Q: What would you have done with this maybe before you started this course, and maybe something change or did you feel differently?

Yeah, well I think probably if I’d been in kinda situation like that 2 or 3 years ago, I think probably I’d be thinking more of like getting a patent and start a company, get my IPO and sell out the stock you know and retire at 30 or whatever but…

Q: Because the climate was different then…

Yeah, even if it wouldn’t be like a dot-com type thing but you know that’s what you’d be thinking… but I mean, I definitely after taking the class umm… I think I’d think a little bit more about you know the effect it can have on the entire community and try to have it available for them to develop it, so….

Not being in the “Profession” or having an ongoing Stake: Informants who developed the innovations as part of the studio course worked on projects not directly in their own academic field, and usually did not wish to pursue the designs on a professional basis i.e. do not have long-term “goals aligned” with the project or to “make a living” from them. One exception to this pattern was an innovator who planned to setup a company to manufacture the design; for this reason he patented the designs and kept them private.

“We’re not in a profession to, I wouldn’t say profession … but our aim here, the team’s aim here is not to make a few tents and then mass manufacture it, and then sell it for this and to make a profit of this.”

“Well as myself, because of the stage of my studies or career I would leave it open just because I don’t have the connections or the… goals aligned with this type of project right now. I suppose, say if I was doing my PhD thesis on this, then I would want to may be keep working on it then, things would be different.”
“But in general with this type of technologies what we’re trying to do is to fill a social need … in the most open view to keep it available. If it was the type of technologies where you think you can make a living out of it, then I think things could be different.”

A perceived Engineer Ethic towards independent design and IPR: When asked about open collaboration and peer-review, informants suggest that it simply did not occur to them in many cases and the institutional setting at MIT often reinforces the notion of working independently (or within the team) to sort out technical issues. This is often a result of an independent engineering mindset at MIT, sense of ownership in a team project with academic incentives to produce solutions within the team, and finally time-constraints pushing the team to solve the problem rapidly or conversely a lack of urgency contributing towards a closed team effort, preventing them from actively seeking external help.

“It's also ego, its also us saying “hey we’ll figure it out” and everyone of us in this institute has that … its also you know we probably have something in our heads that we haven’t put on ThinkCycle and everybody says “what about this”, you know its not done yet, it’s a work in progress and everybody gets very defensive about their ideas.”

Q: For example the Phase Change Material (PCM), one could argue that why don’t you have 1000 brains look for a PCM instead of you yourself looking for it. One could argue…

Yeah, one could. It never occurred to us. We could of course put something on the website saying, “If you have any ideas of PCM let us know”, but its a team project. I mean now that you brought it up, I’d say well we’ll figure it out – if we’re under some time pressure, lets say come August, 3000 babies are going to just die, we’ll so ok, but yeah…

Q: So as a team project, you’d like the team to sort out these challenges within the team?

These questions that you’re bringing up, I mean we haven’t thought about it, it hasn’t crossed my mind to even put it up on ThinkCycle, to say “we’re looking for this, let us know.”

In addition, there is a notion that most engineers do not really wish to be concerned with the messy business of IPR, though we find later that others do indeed find themselves getting involved when their projects emerge “above the radar”.

“ThinkCycle has 2 aims where one was the design process and one was IP and market test, market research etc. So there are several design engineers, me included, who would not want to even be bothered with the IP section of a project like this. And I’m in that category.”

Conflicts with seeking Broad Patents in Academia: One informant felt strongly that broadly applicable patents in academic settings was inappropriate, particularly if it prevented others in academia from freely pursuing research in that area. There was an inherent conflict of interest in patenting ideas directly related to ones own primary area of research.

“I don’t think that academic environments should really be patenting very specific inventions that can be broadly used.

…

And again also, as I said before I don’t think academic environments should really be patenting very specific products for anything, I guess maybe it’s a little bit of a traditional view of IP but umm… I still feel uncomfortable about intellectual property in academic environments. It gets too close to conflict of interest, I think it’s a little bit tricky to deal with.

…

In which (situation) I would patent? Yeah, I mean if I had, if I had, something which I thought was broadly applicable, I mean it wasn’t going to be my direct research focus … then I think, and its not something that I feel would harm people’s ability to do research, then I think that’s something that’s worth protecting… (which) I don’t think it would be really useful in an academic context.”
There is an implication that the innovators could have published their work in academic journals instead of going the patent route, had this been in their area of academic interest or a greater awareness of such publications.

"Q: Alternatively if you had published this in the right journals or in the right medical community, do you think it would have had a similar or different impact?"

"Umm, it’s hard to say. And I don’t know… there are probably design journals for medical technologies that we could have published this in… umm… but it’s impossible to say how… umm… things would have worked out differently. I mean we, umm… we didn’t know and we didn’t have time to look into it."

Institutional Context, Culture and Support for Patenting

The decision to seek formal IPR such as patents often seems tied to the culture of the institutional setting at the time, i.e. the academic, corporate or collaborative partners involved. In the interviews we see examples of how each is perceived to influence the informants differently.

The role of the Technology Licensing Office (TLO) at MIT greatly facilitates the patent process, lowering the overhead (both financial and administrative) and perhaps increasing the incentive to file for patents. In addition, many departments greatly value patents filed which is often regarded as a metric for the quality of research conducted by other departments or funding agencies.

"In my case it was because somebody wanted to do it and the opportunity was there and there was not that much effort on my part to make it happen. So like MIT and this company really wanted it to happen and I just went for it. I don’t think I would have pursued it myself independently."

The nature of serious communication from external companies and lack of understanding of how to deal with IP, lead the team to seek help from the TLO.

"And so given the sort of lengthy detailed emails they were sending out, we decided to talk to the Technology Licensing Office (TLO). And that's what started that process."

... We pretty much followed the TLO's lead. They instructed us in the process of patenting and documentation, and they took over all the negotiations with the company. So for us that was perfect, because we were all overloaded at the time with other thesis responsibilities, so for us it was the ideal situation to have what seemed to be a competent organization taking care of all of the legal stuff."

There was a perception of TLO as a fair and competent organization the students can trust. Patenting through the TLO seemed to suggest a low-overhead option for the team, in that situation. However later the informants also recognized the amount of work involved in actually following through with a patent in terms of lots of paperwork and regular correspondence they must deal with (see the quoted dialogue on “Patents as Mystifying” in previous section).

In another case the patent was avoided after debate within the department. But it points out the low overhead required in actually filing a patent, and the financial support provided at MIT.

"So (co-inventor) was going to put together basically the technical information for the patent, and it was basically just be a no-brainer, but umm… (patent was not filed after debate with departmental IP Committee)"

Was the default option provided to the team by the TLO to file for patents? One might wonder if the team was provided alternatives such as formal Open Source agreements legitimized and regulated by the TLO that may have been an appealing option as well.

Doing the project in the context of real-world collaborations with manufacturers and stakeholders in developing countries would clearly influence the nature of IPR adopted.

"The fact that we had no connections what so ever in a developing country during the design made it feel very much like an academic exercise, and sort of an isolated umm… intellectual exercise. So to
make this a much more meaningful exercise to solve this problem, that would have to happen. So then, the questions of patent or Open Source would be answered by, would almost already be figured out by the people with whom we were working. So if the manufacturer who was interested in having this problem solved was amenable to the idea of Open Source then that's wonderful; my suspicion is that they would want some more exclusive right to the idea.”

However, another team finds that their decision to patent and license to a company makes them less open about their designs.

“Umm… so I’ve noticed that our relationship to our… the way we think about our designs has changed now that we’ve gone through the patenting. Whereas we’re not as interested in sharing the ideas, just because we don’t know what the restrictions are for the company who’s licensed the design. Whether we’re going to spoil things for them by talking about it.”

D. Role of Formal or Informal Social Contracts
Moderating the Transparency of Open Source Design: There is a desire to moderate the social contract for Open Source to take into account reciprocity, intentions, stake for future decisions and credit assigned among a distributed online community.

“Q: Do you think its possible develop a project in an open source manner and still patent. Do those things have any tension – can those things still work together?

It will be difficult, umm… assigning where ideas comes from is what IP is about. And that isn’t properly documented and understood in the historical way, then I don’t think they’re compatible. So Open Source to a point that the level of transparency needs to be moderated in some way.

Q: Ok, what do you mean by that?

Umm… for example if a group is working on a device and every idea is available, completely transparent, people can see everything but not necessarily contributing, that all the information is out there and you can’t say weather its been released or not. In terms of moderating I think if you had a well defined understanding of who the contributors were for a project, and agreement on what the of the individual is as to their intentions with outcomes… if they’re going to profit, it can’t be… [garble]

One informant suggests the need for some form of “mentoring” agreement to allow students to trust the intention of external peers, however he also recognizes how that might detract some from participating.

“In an open community its harder to distinguish those intentions, so there could be people who are interested in just sort of siphoning off the innovations, but I mean that’s the risk. So it could be that by having a mentoring agreement that could somehow deal with that, but again how many people are going to be turned off by the mentoring agreement and want to have nothing to do with the class. Some sort of understanding that you’re there to assist the students but not to steal their ideas.”

Another form of agreement desired is one that allows people to use or license the designs with compensation, accreditation or respect for the original innovators. An aspect of the agreement would entail whether the IP would be shared among the contributors only or with the overall community / nonprofit entity hosting the online community.

“If I see an idea on ThinkCycle website and I have the resources to patent it and you (the inventor) don’t do it after a year, which is the time limit, then I could do it right? Is that possible? Then that’s a danger too. So maybe an agreement with the online community members to actually decide what you want out of the community, if you want to have maybe a personal patent or maybe a patent that belongs to the NGO?”

“I would hope that in the future there are enough people who think to go to that site to search around for things of interest, such that a company who’s in Africa can go there, see designs and if they want, hopefully there’s some sort of, not as in the common sense, but some sort of a respect for the
One informant suggested the need to setup an agreement to ensure part of the royalties from successful designs are set aside to support the ThinkCycle entity.

“They went down a very traditional route, the designs came out of the class and a company came and talked to them and then… (they patented) and basically ThinkCycle is, there’s no formal arrangement to have any money the generate come back to the organization, whatever it is. And so to me that seems a little bit like a bad precedent.”

Would a nonprofit entity with appropriate IP and licensing arrangements provide incentives for innovators to avoid exclusive patents, in favor of copyright, GPL-like license agreements, pooled patents, etc. There is some indication that innovators would consider adopting a more open community-centric IPR approach if a legal nonprofit entity provided suitable arrangements and legitimate cover.

“If you patent things to MIT it may be hard for you to control what happens with the technology or with the idea, so if you have an online community that’s based on a class at MIT that’s not going to be complicated. But if you have a totally open source thing that’s run as an NGO (nonprofit) then I would rather have everything accessible online. Oh but I guess the problem is if you don’t patent it and publish it, then somebody else could do it right? If I see an idea on ThinkCycle website and I have the resources to patent it and you (the inventor) don’t do it after a year, which is the time limit, then I could do it right? Is that possible? Then that’s a danger too. So maybe an agreement with the online community members to actually decide what you want out of the community, if you want to have maybe a personal patent or maybe a patent that belongs to the NGO?”

What would be an appropriate social contract for IP (formal or informal) developed by a collaborative community online? How should a potential nonprofit entity administer such IP in a fair and legitimate manner to ensure both reciprocity to innovators and timely access to innovations for developing countries?

In the last section I outline the key desirable attributes for formal and informal IPR mechanisms and we will consider a framework within which appropriate policies, social contracts and incentives can emerge.
5.4 Emerging Patterns of Intellectual Property Rights in Collaborative Design

Based on the interviews, the 7 projects are categorized along 2 variables: 1) level of public online disclosure and 2) the nature of intellectual property rights (IPR) desired, as intended at the time of the interviews. Conjoining these two variables allows us to consider four main emerging patterns adopted by participants. In table 1 below, most cases fall within quadrants 1 and 4 (full disclosure vs. proprietary) which seems predictable, however two cases fall each within quadrants 2 and 3, which seems somewhat surprising at first. We will now examine the characteristics and rationale for why participants adopted these four patterns more carefully below.

<table>
<thead>
<tr>
<th>Public Access (Open online disclosure)</th>
<th>Informal IPR (No intention to patent)</th>
<th>Formal IPR (In process of filing patent)</th>
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<tbody>
<tr>
<td></td>
<td>Hand Power Generator</td>
<td>Cholera Treatment Devices</td>
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<tr>
<td></td>
<td>Low-cost Library</td>
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<tr>
<td></td>
<td>Bio-sand Filter</td>
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</tr>
<tr>
<td>Private Access (Restricted online disclosure)</td>
<td>Passive Incubator</td>
<td>Low-cost Eyewear</td>
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<tr>
<td></td>
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<td>Smart-canes</td>
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**Table 5.1:** Categorizing 7 design innovations along a typology of four IPR patterns emerging from conjoining the level of online disclosure vs. nature of intellectual property rights desired.

The four emerging IPR patterns can be summarized as follows: (ordered by most public and informal to most restricted access and protected IPR)

**A. Informal-Public IPR:** The innovators develop the project in an open manner, disclosing evolving designs regularly online and seeking public peer review and contributions. At this stage of the design they do not intend to seek formal protection like patents (though this may change in the future given a one year deadline to patent). This approach seems most compatible with what are today considered “Open Source” principles in the software domain. However, the rationale for taking this approach with hardware is different in many cases here.

Among the 7 MIT studio projects, only 3 projects (less than half) adopted, what is generally considered an “Open Source” approach to their design process and IPR. This was surprising as the course instructors expected most teams to go this route, which had been emphasized throughout the course. We will now consider the key factors why some teams did indeed take this approach, before we examine why others chose not to.

**Key characteristics of these projects:**

- **No prior patents:** Neither of the informants of these projects had filed for patents in the past, though they are generally aware of patent issues and process.
- **Primary field of academics/research distinct from project area:** All informants had academic majors (Physics and Aeronautics) that were not directly related to the project areas they worked on. Informants stated that they did not have ongoing “connections or goals aligned with the project”. Hence, as the project was not directly relevant to their core interests, they did not take a greater stake in it.
- **No plans to continue development:** All informants are graduate students who wish to focus on their own academic areas, and had no plans to continue working on the projects or in potential product development/business opportunities.
- **No sole ownership of designs perceived**: All informants inherited the projects from other individuals, who had either conceptualized the problem or the early designs. Hence, they did not feel ownership could be attributed entirely to them. This lack of direct ownership may have lead to a sense of responsibility to leave it in the public domain or not to take additional personal stake in the project.

- **Lack of team contributions**: The informants worked largely independently on these projects without other team members contributing regularly. Hence they frequently requested others to review their designs or postings online.

- **Patentability of technology unclear**: Though the projects were considered novel, most informants felt that additional work needed to be done to make a case for patenting the designs. However, one participant indicated that the design and prototype was fairly complete, but had debated and not clearly established whether it was patentable with faculty peers in his department.

- **Below the commercial radar**: The projects were not perceived as having high value in the market, hence under the commercial “radar”. The informants felt the designs would be more valuable in pedagogical, research or nonprofit settings, and hence should remain accessible in the public domain.

**B. Informal-Private IPR**: The innovators decide that the project should be made available in the public domain (eventually) and do not intend to seek formal IPR protection. However, they initially choose not to disclose the project designs publicly online, preferring instead to develop it further in a shared but restricted “private” online space.

Among the MIT studio projects only one team followed this pattern, Passive Incubators, however there is an indication that at least one other team (Cholera Treatment Devices) would have adopted this approach to some extent, if the facility for shared private online spaces had been available at the time. We will now consider the rationale for this seemingly contradictory approach.

Key characteristics of these projects and rationale:

- **Patentability unclear**: Informants were not entirely convinced if the concepts were novel enough or at a stage that they could be patented.

- **Patent inappropriate for target group**: A patent was considered obstructive for the target community of low-income end users in developing countries. Key concern was to make the innovations accessible to the community. Informants did not believe that patenting and licensing issues would be effective in this setting.

- **Perceived as “Team Project”**: The informants worked closely within the group to strive to resolve the design issues; it was considered a “team project” for the course and they did not seek external contributions by the general public. Although they consulted many domain experts throughout the design process.

- **Preventing design from being “exploited”**: Concern that the design could be “exploited” or misused if made publicly available at this stage. Wished to work out most technical issues before allowing a technical validation of the project, particularly with concerns for infant safety.

- **Need for Closed Working Space**: Informants claimed they did not wish to make the designs public until they had a “working device”. Informants desired a “closed working environment” to “kick around ideas” before they are made available publicly. There was a sense that there should be freedom to make rapid design iterations without having to disclose all unrefined (or “stupid”) ideas. The institutional setting and expectations for validated results may reinforce an attitude towards a keeping the design phase proprietary. They did not wish to detract expert reviewers from contributing, by exposing them to preliminary unrefined ideas.

**C. Formal-Public IPR**: Innovators make their designs publicly accessible online, however they choose to file patents within one year of disclosure. This somewhat contradictory
pattern is rarely seen in commercial settings, however it may be more common in academic settings though it is likely that some core design concepts may be kept proprietary.

Among the MIT studio project, only one case exhibited this pattern – Cholera Treatment Devices, which was somewhat unexpected by both instructors and team-members.

The rationale for open disclosure and then patenting include:

- **Seeking rapid adoption and impact:** The team selected the problem domain to have rapid and worthwhile impact, requiring broad access to the design so that it can to be adopted widely. For Cholera treatment in rural or relief settings, wide availability of such techniques was perceived to be more critical.

- **Learning through Design:** The informants pointed out that the design exercise was a learning experience for them, and they tried to document the project results as they would any research paper in academic settings. They did not initially seem to think of the project in terms of product development (and the notions of IPR that come with products), but more in terms of problem solving.

- **Concept emerges in the “Radar” of Commercial Interests:** The team took up patenting only months after the project was completed and disclosed online, as a means for addressing needs of companies, which contacted them. Previously the idea had been considered “under the radar” of commercial interests (i.e. unworthy or unimportant for commercial production).

- **Patent as enabler for Commercial Production:** The team felt the exclusive access to the IP through licensing the patent, would allow a company in the US the right economic incentives to manufacture and distribute the device.

- **Legitimacy of Patents in the Problem Domain:** The team seems to have realized that to make their concepts more legitimate for medical institutions or companies to adopt, the patent serves as a rigorous form of documentation in the public domain. It may provide a level of assessment and formal peer review that justifies other organizations to take the project seriously, particularly in the medical domain.

- **Patent Protection restricted to US market only:** The team only took up the patent when it was clear to them that the patent would only apply to the US and that the designs would remain openly available in developing countries.

- **Control over quality of design:** The team wished to retain some control over how the design was adopted by companies manufacturing it, primarily to ensure the quality of the product in addressing the critical treatment of Cholera.

- **Patent as recognized accomplishment:** Members of the team considered the patent a “privilege” and a form of public award that provided credibility and recognition among peers, companies and for future academic/job positions.

Key characteristics of these projects:

- Team consulted with many domain experts at Medical schools and hospitals. They made transcriptions of most such discussions available online. Hence there was an open-research oriented mindset as the project evolved.

- **Commercial Interests and Inquiries:** As the project began to receive inquiries from companies, the team began to consider how to formalize the IP to address these emerging needs, in conjunction with advice from the Technology Licensing Office at MIT (which clearly has a mission towards formal IPR arrangements).

- **No prior experience in patenting:** No members of the team had filed patents in the past; hence the notion of formal IP protection was not considered in the early stages.

- **Breakthrough vs. Engineering:** Informants did not consider the design ideas as major “breakthroughs” but rather “nice engineering”. Hence the notion of patenting did not seem appropriate initially.

- **No disadvantage in keeping designs public:** The team did not perceive any disadvantage in leaving their designs publicly available online after patenting it.
Proprietary access was not requested by either the company licensing it or the technology licensing office.

**D. Formal-Private IPR:** Innovators choose to keep their IP under restricted disclosure, making the content available to a few selected participants only. At some point the innovators choose to file for patents to formally protect their IP. This pattern can be generally recognized as that which operates with most patentable innovations, which are not disclosed publicly until the patent is granted. Hence, for most innovators this may be considered the standard approach towards IPR.

Among the MIT Studio projects, we find that informants from at least 2 projects indicated their desire to adopt this approach in dealing with their IP, *Low-cost Eyewear* and *Smart-Canes for the Visually Impaired*. The instructors considered this approach the least desirable, as it seemed counter to the objectives of the course and toward sharing and learning outcomes. However, one must recognize the rationale for participants to adopt this approach to better understand some of the real-world constraints affecting them.

The most commonly cited reasons for doing so include:

- **Preempting Potential Infringement:** Preempting others from patenting the idea first to avoid future patent infringement.
- **Protecting from loss of revenue:** Preventing others from making profit on the innovation without adequate recognition and reimbursement to the innovator.
- **Control for Support, Profitability and Speed to Market:** Realization that product may be highly profitable in a commercial setting, and justifying the need to patent to help rapidly fund the product manufacturing and business development.
- **Scale above “sub-threshold”:** Recognizing the scale of the implementation required to make project successful requires greater funding and control. Project is perceived as being above the “sub-threshold” for scale that it can be profitable on its own if developed well.
- **No Joint Contributions or Reciprocity:** As no one else seemed to be interested in contributing in the early stages of product development, the participants decided to abandon an open source approach and operate with restricted disclosure.
- **Compelling but Imperfect Technology:** Putting off field trials or public disclosure of an unfinished or imperfect technology to avoid “negating the technical evaluation” for future patent filing.

**5.4.1 Summary: Trajectory of how IPR Patterns were adopted**

**A. Informal-Public IPR:** Nearly all participants initiated their projects with this pattern in keeping with the general spirit of the course for open access of innovations to communities. At least 3 projects remained in this mode. These participants did not consider the projects directly related to their fields and did not have plans for continued development. They believe their projects are either unpatentable, under the commercial “radar” or require research or community involvement for continued development or long-term impact.

Subsequently at some stage of the project, a few participants chose to take one of several different paths:

**B. Informal-Private IPR:** Some participants felt the need for a closed working space to flush out the conceptual designs among the team and to refine the design before disclosing them more publicly at a later stage. These participants do not indicate that they have any plans for formal IPR. Conversely, other individuals take this approach since no one else seems to be contributing cooperatively to their projects; hence they abandon a purely open source ethic.
C. **Formal-Public IPR:** When solicited by a company, one team decided to undertake formal IPR protection by filing for a patent, while keeping their designs publicly available online. They feel a patent provides legitimacy in their problem domain and serves an as enabler for commercial production. However, they choose to patent under the condition that it primarily applies to the US market, leaving their design accessible in developing countries.

D. **Formal-Private IPR:** Finally, some participants who chose to keep their designs in a closed working space (pattern B) decide that their projects have emerged above the commercial “radar” or “sub-threshold” and may have potential for profitability. They choose to keep all design proprietary and pursue patent filing, to preempt potential patent infringement, loss of revenue or credit, and avoid “negating the technical evaluation” by public disclosure of their unfinished technology. These participants also take a greater stake in the continued development of the product and its implementation in the field; hence they wish to have a greater level of control and leverage from the IP.

This evolving trajectory can be summarized in the table below:

<table>
<thead>
<tr>
<th>Informal IPR (No intention to patent)</th>
<th>Formal IPR (In process of filing patent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Access (Open online disclosure)</td>
<td>A. Open Source</td>
</tr>
<tr>
<td>Private Access (Restricted online disclosure)</td>
<td>B. Closed Source</td>
</tr>
</tbody>
</table>

**Table 5.2:** Trajectory of how innovators adopt different IPR patterns (A-D) at various stages of their design process (1-4) over time. Note that some participants remain within stages 1 or 2.

Hence the 4 main trajectories among these patterns are:
1. Maintaining the project as Informal-Public IPR (a form of Open Source). Most participants start here, while some (less than half) remain within this pattern.
2. Keeping the project within a team with Informal-Private IPR (Closed Source), disclosing some design publicly over time, but with no intention of patenting in the future.
3. Restricting the disclosure of the design process to a private online space and then seeking patent filing. The designs remain proprietary until the patent is granted.
4. Going from a publicly disclosed project with informal IPR to that of formal IPR with a patent filing, while continuing to disclose the designs publicly online.

Key episodes that triggered changes in adopting specific patterns include:
1. *Pedagogical context of open collaborative design studio* – the nature of the class with an emphasis on socially-motivated problem solving and open source principles, would have motivated many to initially adopt a Informal-Public IPR pattern for their projects. Participants feel that designs remain under the commercial “radar” and are most valuable in their current state, if accessible within pedagogical, research or nonprofit settings.

2. Design teams or individual innovators (working alone) switch to Informal-Private IPR, under two different conditions: (patentability of the designs may be unclear at this stage)
2.1. *Perceived need for closed working space among design team:* As a design team begins to flush out many unrefined and alternative design iterations, they choose to setup a closed online working space, particularly if there had not already been much external public contribution in the design process. There is also a concern that the preliminary project concepts may be used inappropriately ("exploited") or misjudged.

2.2. *Lack of reciprocal contributions:* In some cases, innovators will go “closed source” if they do not feel that their project is eliciting much interest among the general public, such that no external contributions are being made. In their minds this violates the principle of a cooperative open source project, with a lack of reciprocity i.e. they put ideas in the public domain without reciprocal contributions towards its ongoing development.

3. *Recognition that a project is above "sub-threshold":* Innovators at a certain stage of the design cycle, recognize that 1) the technology is novel and patentable, 2) the product may be highly profitable in (first-world) commercial settings, 3) the scale of the project requires greater product development, funding and control for maximally fast implementation, 4) they take a personal stake in the continued product and business development. This justifies for them a *Formal-Private IPR* pattern to maintain the designs as proprietary for greater leverage and control, at least until patents are granted. It is expected (from the interviews) that most participants would make designs publicly accessible after receiving the patents (i.e. moving into pattern D).

4. *Solicitation for licensing by commercial entity:* Participants operating under an *Informal Public or Private IPR*, when faced with a serious commercial interest seek some means to formalize their IP. Most cases so far do so by filing for patents, while others may choose to adopt copyright or release a formal publication. Either of these options would give them a public recognition over their informal ideas and enable to them to pursue licensing options with the commercial interests. However, some of these participants continue to keep the designs under public disclosure as they are covered by the patents and do not wish to take greater stake in its development to assert additional control over the IP in developing countries. Hence they adopt a *Formal-Public IPR* pattern.

Hence patterns A and C can be considered steady states, which are eventually adopted by participants even if they choose to keep the ideas proprietary during the design process.
5.5 Formulating New Frameworks for Intellectual Property Rights

5.5.1 Key Attributes and Incentives for IPR in University Settings

The interviews with informants suggest a number of key incentives and attributes that emerge in their notions regarding IPR. Before we consider whether either patents or Open Source approaches are more suitable mechanisms, we must examine the nature of such perceived incentives and attributes to inform a wide array of options regarding IPR, both formal and informal. Any solution proposed ought to consider how such attributes may be addressed or intentionally relinquished to support the IPR goals desired.

I. Recognition: A key motivation for innovators is to provide some kind of legitimate recognition in the form of public tribute, award, publication or credit for their work. Open Source often falls short in that it does not provide a direct and immediate public recognition, while patents retain such a stature. Special awards, publications and credit mechanisms play an important role to encourage innovators, particularly in critical problem domains that do not receive much attention from either industry or academia.

II. Control: An overwhelming rationale for seeking formal IPR is attributed to having some level of control over how the ideas are utilized by others, in terms of appropriate usage, quality of production, leverage to negotiate terms of use or access, and ability to commercialize if needed. It is often assumed that simply filing for patents provides this notion of control, however the nature of licensing agreements and institutional support truly enables one to negotiate such terms. Strengthening the licensing and institutional support for innovators is an important aspect to emphasize in any IPR approach.

III. Preemptive Protection: Innovators have a desire to prevent others from unfairly staking claims to their design concepts, and in effect risking infringement on their own work. Mechanisms such as patent filing, research abstracts, or publications play that role. In addition, legitimate online registration of one's idea and public awards may also provide accreditation and counter such infringement claims. Prof. Anil Gupta [2000] has suggested a global registry to protect grassroots innovators. Using an online system like ThinkCycle to archive ongoing design ideas can also provide a legitimate "paper trail".

IV. Commercial Enabler: Many innovators seek to have their designs go into production such that they can be more readily accessible or subsidize expenses for access in developing countries. There is concern that without legitimate patents and exclusive licensing, companies will not find it competitive or profitable to manufacture their innovations. Such market dynamics differ in the Open Source software industry, however it is an important consideration with respect to hardware products. Any IPR policy must enable above "sub-threshold" innovations to receive legitimate licensing and institutional support to encourage commercial production. Alternatively, community-based or nonprofit production and distribution mechanisms could also be explored and supported e.g. for low-cost or locally produced agricultural, health and emergency relief technologies.

V. Real-World Legitimacy and Learning: Informants felt it important to gain familiarity with the process of dealing with IPR issues in real-world settings i.e. doing prior art search, creating technical drawings and patent filing – as such tasks were considered natural part of designing products. Clearly such aspects should be emphasized in the design and learning process regardless of IPR approach adopted. In addition, many informants felt that gaining formal IPR such as patents gave them legitimacy and leverage while talking to companies, organizations and faculty peers. Hence, legitimate recognition plays an important role in supporting innovations to move beyond academic settings to the market.

VI. Unfettered Access for Target Community: All informants strongly intended for their innovations to be easily accessible by the target users or producers in these settings.
However, their approach differed depending on the level of stake they assumed in carrying it further (usually with restrictive disclosure) or leaving it for others to continue developing (keeping it publicly accessible). This intention to provide maximal access to the target communities made the deferred and territorial scope of patents an appealing option. Alternative IPR arrangements must support at least such access conditions.

VII. Moderating Transparency of Public Access: There is a desire to moderate the level of disclosure of ongoing ideas at various stages of design to selected individuals or groups. In many cases, informants wish to have a “closed working space” to selectively share only well-posed designs publicly while being able to “kick around ideas” informally among the group. The institutional setting and expectations for validated results reinforces an attitude of gradual moderated disclosure and than fully transparent access. It is important to find ways to support such moderated transparency in the online design tools and IPR policies e.g. allowing publication of design abstracts rather than full disclosure.

VIII. Social Reciprocity for Cooperative Sharing: The apparent transparency of Open Source implies some level of cooperative design contributions or peer-review. In the absence of such reciprocity, innovators may not feel much incentive to continue to openly disclose their evolving ideas in a public online forum. There is a need for some form of formal or informal agreement, a social contract, allowing innovators and potential contributors to agree to terms of access, accreditation and outcomes. The use of GPL-like licensing agreements in the Open Source software community clearly play this role; however one must consider if and how such formal agreements should be setup for collaborative hardware design. One example is the Simputer General Public License (SGPL)\(^{59}\) that must be examined carefully in the context of online projects on ThinkCycle.

IX. Demystifying the IPR Process: To be effective any set of IPR alternatives must ideally support several key attributes for both innovators and adopters: 1) easy to understand, 2) low-overhead to setup and implement, 3) affordable, 4) appear to be fair and reciprocal, 5) clear outcomes of the policy if adopted, 6) enforced and legitimized by an impartial, competent and recognized entity. The interviews suggest that the patent process is both generally overwhelming for innovators and yet has lower barriers for entry in institutions like MIT (with the support of the TLO and incentives from MIT departments). Conversely, formal IPR policies around Open Source are not well understood by innovators or supported by the institution, even though open sharing is implicitly encouraged. Hence there is a role for the institution and potentially intermediate entities (a recognized nonprofit entity administering such IPR) to provide awareness, consultation and actively support a range of IPR policies appropriate under different settings.

X. Institutional Support: In my mind, the institutional setting and support (implicit or formalized) provided to innovators has the greatest influence on the nature of IPR adopted. The interviews suggest that the institutional setting at MIT promotes a spirit of open sharing, socially responsible action, and rigorous validation of results. However the same setting also legitimizes formal IPR approaches like patents and actively supports students and faculty in filing patents. Conversely, there is little if any formal support for alternative mechanisms like Open Source, though a great deal of debate on openness in academic, pedagogical and research programs is beginning to emerge at MIT. Hence, the institutional policies and case examples have a strong role to play in shaping both the dialogue and nature of IPR adopted by its members in any university and research setting. In addition, there is a role for intermediate entities that can inform, administer, and support appropriate IPR policies. To be effective, such entities must be setup with legitimate recognition and support in industry and academia.

\(^{59}\) http://www.simputer.org/simputer/license/
5.5.2 Supporting Formal and Informal IPR for Critical Innovations

The outcomes of this preliminary study indicate the role of both formal and informal IPR mechanisms to support innovations in university settings. I quickly outline several approaches that I feel are important to consider, based on the framework cited in section 1.5 and the incentives emerging in this study: *(this is a draft outline that must be refined and expanded)*

- **Institutional Support** for an array of IPR options such as Experimental Use, Patents, Copyrights, Open Source, Patent Pooling etc. There should be an emphasis on awareness and education as well as supporting various licensing arrangements to ensure fair and timely access. In addition to the Technology Licensing Office, there is a role for other entities within the institution to provide awareness, education and support.

- **Awards for Innovation in Critical Domains** play an important role in providing legitimacy to such an area as well as recognition and incentives for maintaining more of the design concepts in public domain. There is a strong need for MIT and other leading industry, academic and government institutions to support such awards, not unlike the Pulitzer Prize in literature and the Fields medal in mathematics.

- **Forums for Publication of Research** such as conferences, journals, newsletters etc would encourage alternate means for publishing IPR in critical domains. The “development by design” conferences are a step in this direction; it is currently being expanded to support an international committee of experts for peer review and publication of the proceedings in the ACM Digital Library for greater legitimacy. In the future appropriate peer-reviewed Journals and online abstracts should be introduced.

- **Licensing Arrangements for Cooperative Product Design** must be carefully considered in online systems such as ThinkCycle to provide greater trust and reciprocity for product development and IPR outcomes. Such agreements (similar to the SGPL) should be setup online in a simple and clear manner with low overhead to participate. This is not unlike similar arrangements on Open Source software repositories like SourceForge.net and Savannah maintained by the Free Software Foundation.

- **Moderated Online Design Spaces** that support closed working areas for the teams while allowing them to share evolving designs publicly as needed. Private ThinkSpaces are already provided on ThinkCycle, with the option to publicly disclose selective content.

- **Online IP Tracking for Open Collaborative Design** would allow individuals and teams to maintain a “paper-trail” of the evolving design concepts, and enable future patent filing or preemptive protection against potential patent infringement claims. A form of such a mechanism is already in place on ThinkCycle, however with greater peer-review and additional legal aids it may prove to be a more legitimate mechanism for innovators.

- **A Global Registry for Critical Design Innovations** administered by legitimate entities and international experts, would provide an alternative to patents particularly for the small-scale “sub-threshold” innovations that wish to remain in the public domain. It would provide peer-review, paper trail for preemptive protection, and spur interest in the innovations globally. Similar approaches for grassroots innovators have been suggested by many scholars including Gupta [2000]. One needs to carefully consider how such a global registry should be setup and administered to provide the most suitable outcomes. A nonprofit entity affiliated with worldwide organizations could operate such a global repository, to ensure legitimacy, legal cover and assistance for innovators. Alternatively the US Patent Office could consider setting up a similar initiative within its mandate, as an alternative pre-publication or registry for small innovations in critical domains.

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60 http://www.thinkcycle.org/dyd02
61 http://savannah.gnu.org/