Why the Media Lab works—A personal view

by K. Haase

The MIT Media Laboratory distinctively combines a high degree of vitality, creativity, and accessibility. The vitality is evident to students and visitors, especially in the late hours of the night. The creativity is evident as changes and innovations produce very different "products" from year to year, invariably surprising sponsors and other visitors who have been away from the Media Lab for six to twelve months. Finally, these products are unusually accessible to a general audience, and demonstrations of these products are generally exciting and inspirational to scientific and nonscientific audiences alike. This combination of vitality, creativity, and accessibility is part of the reason for the striking growth and public visibility of the lab over the past five years. It is also why many individuals and organizations around the world seem to be very interested in duplicating the model of the Media Lab. However, such duplications require an understanding of what factors have led to this successful combination in the first place. This essay looks at some of the factors that led to the success of the Media Lab, based on my own thoughts and efforts in trying to transplant that success to different contexts.

I divide this discussion into sections on form, content, and style. "Form" describes the structure and products of the laboratory, as lab members and outsiders see it. "Content" consists of the topics of our work and the themes that underlie our diverse activities. "Style" describes the way we do our work, including our priorities and prejudices. All of these are important components of who we are and why we have prospered.

I began to write this essay in the autumn of 1997, after half a year of groundwork toward establishing a "European Media Laboratory" in Heidelberg, Germany. Irreconcilable differences between MIT and the patron of the proposed laboratory eventually led to the dissolution of the relationship (and my departure), but I wanted to write down what I had come to understand about the Media Laboratory. I had also hoped that my understanding might help any future efforts to duplicate the culture and vitality of the lab.

This essay is my point of view, based on my experience at the Media Lab and at other laboratories. Some of my colleagues would emphasize other aspects or leave out aspects that I emphasized. Some things I have certainly missed, and others I may have misrepresented. I am eager to receive feedback in the lab's tradition of "aggressive civility," which I describe below.

This essay does not include everything and certainly presents an idealized view of the lab. There is no question that in the activity of the laboratory we sometimes fail and let students and colleagues down or favor flash over substance. To our credit, we also try to minimize the effects of such failures or vanity, but we are by no means perfect. Overall, however, we do a pretty good job of managing—not without anxiety, long hours, and certain sacrifices—to live up to our ideals. We are a young laboratory, and I hope we can maintain our spirit. If this essay helps us do that, I will be satisfied.

Media Lab form

To an outside observer, the Media Laboratory can be characterized in terms of both its activity and its

products. In terms of its activity, like many research labs and most startup companies, it is a 24-hour per day, 365-day per year, 25 000-keystroke per hour operation with an incredible amount of energy and commitment. In terms of its products, it is an educational program, a research laboratory, and an ever-changing "museum of the future" currently hosting 3.5 visiting groups per day from industry, government, and academia. I will talk more about its activity in the sections on content and style, but it is worthwhile going into some more depth on the products of the lab, which I will broadly categorize as:

- Students
- Outreach
- Demonstrations
- Point of view
- Intellectual property

There are other ways of dividing up this "pie," but this one serves for this essay.

Students. First and foremost, we are an educational program producing graduates with master's and Ph.D. degrees. In addition, hundreds of undergraduates take our courses, participate in our research, and leave with practical skills, different ways of looking at problems, and the experience of having done things that no one else in the world has tried. Our students do most of the work of our research, and their comings and goings are one of our most important sources of activity and diversity. We would not be the Media Lab without our students.

Our students also change the world. Partially, we pick students who are passionate enough to want to change the world and smart and inventive enough to actually have a chance at it. Partially, we change these students by inoculating them with and against points of view, by educating them with the skills and knowledge of our own disciplines, and finally by demanding that they use what we have given them to identify and pursue what they do best. Of course, we do not always succeed, and sometimes our respective agendas collide, but we do pretty well on average, and few of us could imagine a life without the kind of gifted students we are used to here. And I think that most students leave with a sense of satisfaction that they chose to come to the Media Lab instead of another graduate program.

Outreach. As faculty and researchers, we leave the lab frequently. Or, more precisely, we take the lab to many places and bring many places into the lab. From companies, to schools, to senior centers, to conferences and consulting, our faculty and students interact to a great extent with the outside world. The most intense example of this is our director, Nicholas Negroponte, who spends 80 percent of his time circling the globe, combining admonition with invitation and creating a "global Media Lab" through his network of contacts.

In addition, we have pilot projects in Boston and throughout the world, including the Hennigan School in Jamaica Plain (an inner-city Boston neighborhood), the Computer Clubhouse at the Boston Museum of Science, the Silver Stringers group at the Melrose Senior Center, education projects in Costa Rica and Thailand, LINCOS trailers around the world, and the traveling Brain Opera that was in six cities over three years. We try to set up short- or long-lived microcosms of our creative energy in different contexts, producing results that we could never create on our own.

Industry sponsors our activities, and both faculty and students regularly visit sponsoring companies. The lab has more individual sponsors than any other research program at MIT, giving us tremendous leverage in both changing the world and understanding changes in the world. This diverse base of corporate sponsors provides over 90 percent of the funding for the lab, ensuring a diversity of sponsor interests and a remarkable (but not certain) stability of overall funding.

At my first faculty retreat ten years ago, we laughed a lot about our "peripatetic faculty" and that remains the case. Even if we exclude the frequency of Nicholas's travel, each laboratory faculty and research staff member passes through Logan Airport in Boston more than six times a month on average (though this frequency has probably declined as more of us have become parents). It is good that we have excellent students to "do the work" as we spend much of our time with only electronic "feet" on "Cambridge firma." Our students miss us, but they also (usually) do what is right in our absence.

Demonstrations. Though we produce conventional academic products such as papers and articles, our more consistent products tend to be the compelling demonstrations that often dazzle and enlighten visitors, sponsors, and (sometimes) colleagues. Much of the research at the laboratory is funded by consortia that meet twice a year, and there is a continu-

ing expectation that students and groups have new demonstrations for these events. These deadlines combine with (and do not usually collide with) deadlines for conferences and special issues to provide the pulse for the activities of the laboratory. Demonstrations push the limits of our scientific and engineering research at the same time that they make the problems and promise of our research more understandable to sponsors and other visitors.

But is a demonstration a real or useful product? Some academic colleagues sometimes speak about the Media Lab demonstrations with certain derision, as though we are not really contributing to scientific or technological progress with our "flash." When we are called charlatans, we are being accused of presenting technological illusions rather than technological substance. However, I think demonstrations (broadly construed) are more than mere illusions and indeed are the foundation of the scientific and technological progress that we are all seeking.

In defense of demonstrations as science, permit me a brief aside. When the historian and philosopher Thomas Kuhn first introduced his account of scientific revolutions, he proposed that the foundations of science were not theories or axioms but compelling examples, paradigms, that guided both judgment and imagination in a discipline. Subsequent misinterpretation has turned "paradigm" into a synonym for "conceptual framework," but the radical nature of Kuhn's model was to assert that the foundations for conceptual frameworks were paradigmatic explanations or experiments such as the projection of the flight and fall of a cannonball, the combinational regularities of acids and bases, or the selection of moth colors in a soot-polluted ecology (to name a handful). What was so important about this way of understanding science was that it focused not on the supposed connection of science to the world (e.g., "truth" or "invalidation") but on the practical connections and examples that were the basis for a working scientist's imagination and criticism. Far from the tragic misinterpretation that science has nothing to do with the world, Kuhn's way of looking at science brought experimentation—the interfaces of science with the world—into the core of theory making and theory change.

Returning to the lab and its demonstrations, we see that demonstrations are concrete examples of ideas about technology and interaction, and our demonstrations are the paradigms of our discipline. From Sutherland's Sketchpad, to Kay's Dynabook, to Winograd's SHURDLU, to Seymour's Turtles, to ArchMach demonstrations such as Aspen and Put That There, demonstrations are the way in which we define our discipline. And every discipline is based on "demos"—paradigms or exemplars—of one sort or another. What we are missing, and what may have kept the lab from spreading to other contexts, is our hesitation to discuss (*not* formalize!) the issues connecting these demonstrations. It may be that we are too young, or it may be that we are too busy, but we need to have some time for reflection amid our activity if we ever hope to spread our research culture to the world. And we must do that, if only for the sake of the students we graduate and the faculty we are unable to tenure.

Is a demonstration a real or useful product?

Point of view. "Point of view is worth 40 IQ points" is how Alan Kay summarized his experience with Xerox management's fumble of the personal computer. Part of what the Media Laboratory produces is "point of view," and it is probably the most important benefit that our sponsors draw from the laboratory. In exposure to our demonstrations and discussion of their relevance and potential, sponsors have the opportunity to obtain a new point of view on their own companies and markets and (sometimes) the world as a whole. Of course, it does not always happen. Sometimes, "the nickel doesn't drop," and a sponsor fails to change its point of view or changes only in superficial ways (though often we are still funded). But when it does happen, it is priceless.

Of course, the laboratory does not produce any single point of view, nor can it package its point of view into a readily exportable form (though I think Nicholas's *Wired* columns and his book, *Being Digital*, were an attempt at this). Fortunately for us, "point of view" is both increasingly valuable and increasingly perishable as the pace of change in the world increases. There is no substitute for seeing the demonstrations and talking with the students and faculty, since the significance of (for instance) an "electronic newspaper" demonstration may change drastically as the

world changes (the explosion of the Internet) or the audience changes (from a sponsor in the money market, the magazine market, or the newsprint market).

However, we do not have a "lock" on point of view. We have and will increasingly have competitors in our point-of-view business, and we need to know what makes our point of view so valuable. What is important is that we care about both hearing and educating our sponsors and conveying our point of view to them. And our point of view is useful to them because it derives from our understanding of the science and technology, from the imaginations and interactions within the laboratory, and from the fact that we listen to sponsors and prospects about what matters to them. If you isolate the faculty and students of the lab in a bubble for a year, the value of our point of view would certainly decline. We would still be ourselves, but it is impossible to separate point of view from a territory, and part of our value is the territory we are privileged to survey from our laboratory in Cambridge.

Intellectual property. You cannot put "point of view" in a contract as a deliverable, and the lab obtains most of its day-to-day funding from research contracts of various types. Partially for this reason, discussions with prospective and current sponsors dwell on sponsor access to intellectual property. It is a tangible item that accountants and lawyers can get their pencils around; it is an entity whose value can increase with time while staying the same, owned by the same people. As an asset, it can be used to convince boards or managers that being a sponsor of the Media Lab is worth their money.

There are a number of differences in the way the laboratory deals with intellectual property.

The first, common throughout MIT and many other universities, is that MIT owns the intellectual property produced by research funded by private companies. MIT is committed to licensing that property to the sponsors, but ownership resides with MIT. There are various reasons that this is the case, but it encourages university investment in research. Surprisingly, this situation is difficult or unheard of outside of the United States.

The second difference, peculiar to the Media Laboratory, is that licensing is never exclusive. Any sponsor of the Media Laboratory is able to license any property developed by the Media Laboratory, even if the property is derived from research entirely sponsored by another company. I will discuss this policy more in the section on the style of the Media Laboratory, but it is worth noting that it is unusual.

The third difference, and possibly a deep dark secret of the lab, is that the income from the licensing of Media Lab patents and intellectual property has always been nominal. One reason for this may be that we think of our primary products as being students and ideas, rather than intellectual property. Another reason is that we have tended to work in areas where there are enough different ways to do things that the patents we can legitimately claim do not cover enough territory, and we are (fortunately) disinclined to submit the broad and "obvious" patents that are (regrettably) increasingly common. Finally, the nonexclusive licensing policy of the lab may also discourage potential licensors who feel they need to have a "lock" on the technology to succeed in exploiting it.

However, the nominal income from licensing is only part of the story of the impact and products of the lab. Consider computer-managed video, which was first explored in the context of two of the lab's precursors: the Architecture Machine Group and the MIT Film/Video Group. At the time these projects were begun, the idea of combining a television and a computer for anything but scientific visualization was considered absurd. The work produced a few patents, but mostly it produced demonstrations and "point of view." It was that point of view that arguably led to the industry that is now known as multimedia and the digital video subsystems without which no modern operating system is complete.

Summary. The products and formal activities of the lab are diverse and interrelated. Our students are more valuable because of our outreach and point of view; our point of view is more valuable because of our students and outreach; our outreach is more effective because of our demonstrations and our students; our intellectual property is more valuable because of our outreach (market understanding) and demonstrations (proofs of principle). And there are other connections besides these.

The form of the Media Laboratory might be reproduced in another context, but it might also fail to work in other scientific areas or with other "styles of operation." In order to understand "what we're doing," we also need to understand "what we're about": the content of research at the Media Lab.

Media Lab content

What is the "topic area" of the Media Lab? We have struggled for years with trying to work out a "core" of Media Lab knowledge both in early and continuing efforts to define a proseminar for our doctoral students and in later efforts to shape a formal undergraduate curriculum from our activities. These efforts have been hampered in part by a skeptical concern about "premature formalization" and in part by the lab's radical diversity of "research models."

Identifying the intellectual kernel of the lab has also been complicated by the fact that the activities of the lab have been a continually moving target. Skimming the image of the lab captured in Stewart Brand's landmark but dated book, *The Media Lab*, it is hard to imagine our current population of physicists, chemists, and erstwhile fashion designers (among others) as being part of the same lab. Some say that the lab has had such rapid and robust growth because it is constantly reinventing itself: from software interface lab to information access lab to hardware interface lab, keeping all the intermediate stages as it grew. This continual reinvention is one and the same with the vitality and creativity that I mentioned earlier.

In this reinvention view, any consistency or identity of the lab comes not from the "questions we ask" but the "way we ask them." This is tantamount to saying that style rather than content characterizes the Media Lab. There is a grain of truth in this characterization, though it comes alarmingly close to the harsh criticism that "style without content" characterizes the Media Lab. However, I think that we can speak about the work of the lab in a way that threads together the very different moments we have seen in its history and expect to see in its future.

Architectural foundations. The binding thread starts with the perhaps surprising fact that the Media Lab is part of the MIT School of Architecture and was originally, in fact, part of the Department of Architecture. One reason for this was circumstantial: Nicholas started out in the Architecture Department, and his "Architecture Machine Group" was one kernel of the new lab that he and Jerry Wiesner started in the early 1980s. Another reason was that, historically, the Architecture Department was the closest entity MIT had to an "arts school," and so many of the "arts-like" activities at MIT (CAVS, the Visible Language Workshop, the Film Program) gravitated toward the Architecture Department.

However, there is a more profound connection between the work of the Media Lab and the School of Architecture. Architecture (at its best) is an engineering discipline that takes human attributes very seriously. Doorways in buildings have a certain height because humans—on average—have a certain height. Hallways have a certain width because the movement patterns of groups of humans (within a given context) have certain regularities. And atria and skylights and windows are incorporated in architectural designs—in part—because vistas reassure some part of our primate brains desperately seeking comfort in possible escape routes. In short, architecture is concerned about complex technological systems with humans among the considerations. The Media Lab has the same concern but lives on a broad technological "bleeding" edge.

Of course, computer scientists and mechanical engineers and nearly every other kind of technologist will say they care about the effect of their technologies on humans. But in most of these areas, workers take an engineering approach of trying to modularize humans by biometric and psychometric means into components that can be treated like other components. There is nothing wrong with this approach—indeed it is good engineering practice—but it breaks down when different design constraints modularize or reduce humans in different ways. The aesthetic and psychological effects of vistas do not reduce in the same way as the carrying capacity of physical channels: An illusion of a vista suffices for aesthetic and psychological purposes, but the illusion of carrying capacity will only result in collision and frustration.

The architecture approach, if a nonarchitect can be bold enough to characterize it, is a systems approach to the design of artifacts, satisfying incommensurable constraints. Architecture students do not build models of individual supporting beams (though they need to be able to understand and sometimes innovate with them); they build models of whole buildings. In its early years, the lab flirted and danced with cybernetics as a source for ideas about complex interactive systems, but the problem is that the clearest and most accessible results of cybernetics were those achieved by clever reduction and modularization; there was too little meat in the development of "architectural cybernetics" to sustain a lab that was as hungry for intellectual foundation as the Media Lab.

Design, complexity, and people. I believe that the common thread to the work done at the lab is a design approach to complex technological systems involving humans in all their profound and frustrating complexity. For example, spatial imaging relies on our number of eyes and how we use them; wearable computing relies on human properties ranging from load-bearing capacity to electrical capacitance; application-based vision depends on the spatial and temporal predictability of human actions in particular contexts; intelligent information access requires recognizing the structure of human natural languages; electronic newspapers need to create human community as well as filter human diversity; and our flavor of high-tech education relies on creating environments to support children's natural modes of learning.

Without deep science and solid engineering, we would be an arts or humanities program.

Of course, all of these areas also involve both deep science and solid (if imaginative) engineering practice. Without this aspect, we would be an arts or humanities program, and our results would be far less accessible and discrete. For most of us, the results would also be far less interesting. As a program, we have been loath to accept students without technical training and skills, but only because we recognize these skills as important tools rather than ends in themselves. Some elements of the style of the lab, e.g., disciplinary diversity or the focus on demos, come directly out of the content concerns of the lab.

The growing focus at the lab on work with children is part of the same theme if we look at humans systemically. In possibly the most important way, childhood is how adults are formed. In the new directions of the lab, we are becoming increasingly concerned with "reinventing childhood" by wisely using or eschewing technology to repair an institution stressed and often broken by generations of breakneck change. It is among the longest-term and highest-impact directions for the research of the laboratory and addresses human/technological systems longitudinally.

The paradigm for both research and education in architecture is very different from that in the engineering disciplines and the sciences. In research, we are as much concerned with synthesis as genesis; one of the first thesis defenses that I attended as a new professor included the pointed jab: "You expect a Ph.D. for developing glue?" to which the delivered and completely correct answer was "yes" if the quality of the glue brings things together in ways that no one had ever understood before. In education, we ask students to build whole artifacts with a concern for both the integrity of the whole and the quality of the components. Colleagues from more traditional engineering and science backgrounds may look at the components that they understand and be unimpressed, but the point of the exercise is as much the synthesis and integrity of the whole as it is the quality of the components. (Though frankly, I think we make pretty good components too.)

The role of the arts. As this essay progressed, I realized that I was giving somewhat short shrift to the role of the arts at the Media Laboratory. This was surprising to me, as one of the things that drew me to the lab in the first place was the presence of working artists on the faculty. Yet somehow, as I characterized how the laboratory worked and what it worked on, the arts seemed to fade into the background.

There are two explanations for this. One is that art is pervasive in the background, so it is difficult to isolate as an element. The second is that the commitment of the lab to the arts has declined in certain ways over the years. I think there is truth in both of these explanations, but they are inseparable, since I do not think we can continue to have art in the background without having some artists in the foreground.

When I think of art in the background, I think about the craft of making a demonstration, which all the faculty and students at the lab do. Making a demonstration at the Media Lab has a great deal in common with the artistic creation of a "piece": the concern for expression and impression, the concreteness of the artifact, and the iterative development of its structure with special attention to its integrity. In that sense, we try to imbue all of our efforts with a certain artistic sensibility.

In contrast, as a fraction of the population, the representation of practicing artists in the laboratory has diminished. When I came to the lab, about a quar-

ter of the lab faculty included "artist" in their professional identity; today, it is about 15 percent. Much of the reason is that we grow primarily by hiring junior faculty. We have only hired one artist (John Maeda) as faculty since I arrived, and tragically we lost one (Muriel Cooper) over the same period. During the same time, we have hired ten new faculty. Of course, many of those and many of us have artistic passions or avocations of one sort or another, but we would probably not (for instance) expect our artistic activities to be included as prominent parts of our tenure cases.

Another reason for this decline is funding. It is difficult to obtain funding for the arts, and the level of funding is usually below what we can obtain for technology. So we tend to favor obtaining funding for technology and then doing arts "on the margin." This is effective, but as demands increase (for servicing sponsors, writing papers, or advising students), the margins become squeezed.

Notably, in the past year, the laboratory—under the direction of Tod Machover—has begun an aggressive program to develop and recruit for the arts at the lab. Even without this initiative, the lab still far outdoes most other technology labs with our commitment to the arts. It is spread throughout our courses, our seminars, and our colloquia. Every year includes a number of technological or artistic events hosted by the laboratory, and this sets us apart from most other technologically based research laboratories.

Summary. The theme I see running through the research of the lab is a concern for the construction of systems that include people. This goes beyond the usual concern with interface and interaction to a concern with where we put the interfaces and how we structure the interaction. Furthermore, the research looks at this construction as a design process where multiple incommensurable constraints are combined in the final product.

You may or may not be convinced by my argument for the "Media Lab content," but it is an opening for a discussion of "Media Lab style" which is possibly more important to the question of transferring the culture of the lab. Some connections are clear: disciplinary diversity and a focus on complete prototypes are natural requirements for a lab working on complex systems involving people. But others are more independent, and it is important to understand them if we wish to consider how to translate the success of the lab into a new context.

Media Lab style

Some of the success of the lab can be attributed to the historical accident that it started with its focus on complex (mostly computational) systems involving people just as computers began to become pervasive and invasive in people's lives. The first rallying call for the lab (at least for sponsors) was that technology was going to push the people-centered media businesses together. Nicholas's original selling argument, now prophetic, was the convergence of businesses—print, television, and computers—that had originally been relatively independent and free of competition with each other. Publishers and producers did not chronically worry about technological complexity and innovation, and Nicholas predicted (correctly) that they soon would. This made our point of view and the questions we asked vitally important to the companies that took the bold step of sponsoring a new laboratory.

Of course, a historical accident cannot be transferred, but another component of the success of the lab derives from its free-wheeling creative spirit. The sources and rudiments of this spirit are possibilities for transfer, if we can begin to determine what they are.

In 1997, as I sat in Germany trying to determine what the sources of the lab's success were, I came down to four components

- Diversity
- Community
- Churn
- Playfulness and risk

that contributed to the vitality, creativity, and accessibility of the work at the lab. As I said before, some of these flow naturally from the content of the work, but others are independent. To think about how these might transfer to a different context, let us look at each individually.

Diversity: Faculty. During a faculty meeting a few years ago, I realized that the faculty of the Media Lab would be a good core for a small university faculty. We include physicists, psychologists, linguists, computer scientists, artists in visual, dramatic, and acoustic media, filmmakers, storytellers, and (of course) architects. In terms of our avocations, we also

include poets and athletes and philosophers and anthropologists. And there are others I have left out. This is part of what has made the definition of "Media Lab research" so tricky, but it is also what has given us such adaptive potential.

When I came to the MIT Media Lab from the MIT AI (Artificial Intelligence) Lab, I was genuinely concerned about the risk of intellectual inbreeding involved in staying at MIT. However, I comforted myself with the fact that the Media Lab was more distinct from the AI Lab than any other position I would be likely to find (mostly computer science departments and research laboratories). At the Media Lab, my colleagues would be composers and graphic designers as well as computer scientists and mathematicians. Coming to the Media Lab was also, as many told me, a risk: it was not clear that it would be good for my career even if it was a faculty position at MIT. Some of that stemmed from the diversity of the lab and some from the isolation that accompanies it.

The tension between diversity and isolation is an important one. One of my early frustrations at the Media Lab was that there were not many other "computer scientists" to whom I could bring my practical problem solving about algorithms or theory. There is a tension between having diversity in a laboratory and critical mass. Critical mass is vital for productivity; diversity is necessary for adaptability and (to a lesser extent) creativity. One of the smartest things we did for the long-term vitality of the lab was to hold to our focus on diversity by hiring "hard" scientists (Neil Gershenfeld, Joe Paradiso, Joe Jacobson, and Scott Manalis) even when we could guarantee critical mass for neither them nor ourselves.

But faculty diversity may be the most indirect sort of diversity connected to the success of the lab. Two other kinds of diversity, student diversity and sponsor diversity, may be more important even though they themselves depend on faculty diversity.

Diversity: Students. The students who join the lab are of the highest caliber. Also, many different kinds of students come here. As compared to other programs, we tend to enroll more students who have outside work experience as opposed to students coming straight out of their senior year of college. We also have more students who have changed career tracks in one way or another, as well as students with different undergraduate degrees. We could not accept or adequately advise these students if we did not have a diverse faculty, but the diversity of our students allows us to be far more diverse and excellent in our programs than if we were merely relying on the diversity of our faculty.

We generally recognize that our students do the work of the lab, and the diversity of our students ensures the diversity of our work. However, the diversity of students is not strictly correlated with the diversity of faculty. Glorianna Davenport, a filmmaker, is likely to hire computer scientists just as I, a computer scientist, am likely to hire literary theorists, and Seymour Papert, a mathematician/educator, is likely to hire musicians. Students allow our diversity to be a mixture instead of an agglomeration.

We obtain diverse students through the admissions process. Despite the growing number of applications that make the first cut, we have continued to have the whole faculty involved in all of the admissions process and to regularly refer students back and forth among us during the process. This is vital to student diversity, because some of my best students would never have applied to a computer science program, and some of (for instance) Tod Machover's best students might never have applied to a music program. Furthermore, we can take advantage of the critical skills of other faculty to help ensure that we avoid the dilettantes who find the Media Lab tremendously attractive. An interdisciplinary admissions pool and an interdisciplinary admissions committee (ideally involving all the faculty) is one of the ways in which we ensure having the stream of diverse, creative, and competent students.

Diversity: Sponsors. The diversity of sponsors is also overlooked as a source for the vitality, creativity, and accessibility of the lab. One of the distinctive properties of the lab, especially in the context of MIT, is that only a fraction of its funding has come from government sources. The rest comes from a large and diverse collection of private companies. The history of the laboratory has had this collection growing more and more diverse.

Part of the reason for this diversity is Nicholas's desire to create a robust funding base for the lab. For example, the Artificial Intelligence Lab at MIT went through many lean and painful years after the Cold War ended and defense research funding declined. By having many different sponsors, the Media Lab has had a relatively stable funding base independent of temporary downturns in different economic or geographic sectors. A cynic might look at the growth

of the lab in this way as opportunistic: "Which kinds of companies are not giving us money yet? What would bring them on board?" But the diversity of sponsors contributes to the diversity of the lab's activities in a substantial way. And this further contributes uniformly to the vitality, creativity, and accessibility of the lab.

Sponsor diversity contributes to the vitality of the lab, because the kinds of problems brought by sponsors keep us thinking in different ways. We need to do more types of research, because the character of our audience is always changing both as new sponsors arrive and as existing sponsors become fascinated with different research areas within the lab.

Sponsor diversity contributes to the creativity of the lab, because we need to think differently to describe our research to sponsors arriving with different business problems and different context and assumptions. Creativity usually arises from the transfer of structure, insights, and solutions between domains, and a diversity of sponsors assures that we will be thinking in many different domains in the process of developing and packaging our work.

Finally, sponsor diversity contributes to the accessibility of the lab, because we are forced to find ways to describe the significance or difficulty of our work to people other than our colleagues or funding agencies. Overall, Media Lab students graduate with far more communications skills than students at other laboratories, because they have had to regularly describe their and their colleague's work to visitors ranging from many sorts of engineers and managers to CEOs to government ministers. And lest we mistake this for mere glibness, visitors come away (in many cases) with transformed points of view, a testimony to the challenge and value of such presentations. Of course, other programs produce articulate (and occasionally brilliantly articulate) students, but at the Media Lab it is an intense though informal requirement of the graduate program.

Community. Putting different people in the same laboratory or even the same office is not enough. Diversity alone is not sufficient. Success relies on diversity in community. The success of the lab depends as much on what we have in common as on the ways in which we are different. And the establishment of community is a tricky matter.

When the lab first started, Nicholas and Jerry expected that it would soon have competition from outside as other Media Labs sprouted up around the country and the world. This has not really happened, and part of the reason is that the institutional context of the formation of the Media Lab remains somewhat rare but possibly not unique.

One of Nicholas's favorite analogies is describing the organization of MIT in terms of Church and State: the "Church" is the academic structure of departments and programs; the "State" is the research structure of laboratories and centers. Most of the money comes in through the State (research funding), but most of the power resides in the Church (hiring, promotion, degree granting, etc.).

In this framework, the Media Lab has been unique at MIT in being both Church and State. It is a laboratory ("The Media Laboratory") that conducts research and obtains funding, and it is also an academic program (the Program in Media Arts and Sciences) that admits students, hires faculty, recommends promotions, and grants degrees. This has two important points:

- The lab can hire faculty and accept students who would never be hired or accepted by a conventional engineering program (e.g., composers, filmmakers, or graphic designers).
- The primary commitment of the faculty and students is to the laboratory itself.

The first of these ensures diversity; the second creates community.

At other universities that have attempted to create "media labs," such laboratories have generally had one of two forms:

- A corner of some existing department (either an arts program or an engineering program) declares itself a "media technology program" and invites some outsiders to join them.
- The university creates a center between departments, and existing faculty have second (or third or fourth) lives as members of the center.

The problem with the first is that you do not obtain the kind of diversity you need; the problem with the second is that the members of the center have a primary commitment to their home departments and not the new center. And especially for junior faculty, that primary commitment is what determines research directions, collaborations, and even social interactions.

Part of the success of the Media Lab is that it was formed in an institutional context that sustained both diversity and community. Any successful copy of the Media Laboratory will need to be able to sustain both of these things, though they may do it in other ways. But that alone is a substantial challenge.

What else creates community at the lab? Well, of course, we are all really nice people. (Really.) What I mean to say is that the lab has a very strong tradition of a kind of aggressive civility. One of my colleague's comments on first attending a faculty meeting (after having been to faculty meetings at other institutions) was that (1) people were much more open in expressing opinions and (2) they were actually pretty nice to each other. I have yet to attend a nasty faculty meeting or to feel silenced in a faculty meeting. This does not mean that we wear "kid gloves" with each other, but that we tolerate dissension and disagreement. I have on occasion felt ignored (or felt others were ignored), but that is less egregious and destructive than either meanness or explicit or implicit censorship.

How do we manage to do this? (Besides being nice people, that is.) Well, as with many things, money helps. We have always been comfortably funded and that means that we do not have or need to have resource fights as many departments and programs do. The only resource that is tight is space, and we seem to delegate space decisions in effective ways. Also, although I think space is important, we are also aware that it is not always a radical constraint on our productivity, and when lack of space would constrain productivity (for instance, physical lab space), we generally find ways to work things out.

Another reason for the lab's sense of community is, interestingly enough, the low critical mass in particular disciplines. In many places, divisions spring up with fear of others, such as the "logicians," the "linguists," the "compiler writers," or the "New Music folks," as intellectual groups within the faculty are labeled and demonized. This undermines community and absorbs vast amounts of time in politics, generally promoting turf battles that always lead to intellectually parched earth. Though researchers at the lab pay the cost of diminished direct collegiality, they gain the benefit of enhanced interdisciplinary collegiality, which is what the lab should strive for in the first place.

A final source of community at the lab is a focus on people individually. This has two elements. First, the lab is a people-centered laboratory rather than a project-centered laboratory. Second, the lab cares, individually and institutionally, about the people who work here.

Though the lab has hundreds of official projects and probably an equal number of unofficial or not-yet-official ones, the spirit of the laboratory is based on the people who are here. Part of this comes from the diversity of the lab, where projects happen around particular individuals and their students. Part of it comes from the freedom each faculty member has to define his or her own research agenda. Nicholas never tells people what to do (or not do) as their research area; he will be able to pursue funding of some areas instead of others, but the choice of what actually happens belongs to the faculty alone. This sort of radical autonomy is seldom associated with the level of resources and investment provided by the Media Lab.

Being a people-centered laboratory rather than a project-centered laboratory entails a certain degree of risk and a certain degree of scrambling at the interface between the lab and its sponsors. Most of the scrambling is done by Nicholas as he fits the faculty's interests to sponsors and plays "Robin Hood" with the margins. The advantage of a people-centered laboratory is that such laboratories produce bushels of serendipitous results; the penalty of a people-centered laboratory is that the laboratory can be hard to justify to sponsors or patrons who prefer to see products rather than productive processes. But the creativity of a project-centered laboratory is generally limited to the creativity of the management, which almost always leaves much to be desired, regardless of how brilliant and creative the management team may be. And the morale created by a people-centered laboratory generally has an impressive effect on productivity in its designated "official projects."

It is probably impossible to overemphasize the importance of this element of the Media Laboratory's style. Outsiders tend to think that Nicholas "runs" the Media Lab, but in fact his role has more to do with supporting the hired faculty than telling us what to do. Frankly, I think Nicholas might have grave doubts about over half of the projects going on at the lab, but he gives the faculty free reign, and they (over time) produce. It is an almost unheard-of "anti-management" strategy that is risky and sometimes wasteful but works wonders in terms of both creativity and morale.

One reason why this "nonmanagement" style works wonders (and why other management approaches do not in this context) has to do with the character of basic exploratory research. To use the words of the late scientist-philosopher Gregory Bateson, basic exploratory research is on a different "logical level" than either production or advanced development. In part of his analysis of logical levels, Bateson compares how one aims a rifle and how one aims a shotgun: when aiming a rifle, immediate momentary adaptations help; when aiming a shotgun, they hinder. The unit of adaptation for shooting a rifle is the moment of squeezing the trigger; the unit of adaptation for shooting a shotgun is the whole motion that shapes and directs the cloud of shot emerging from its barrel. Basic exploratory research is like aiming a shotgun: it is wasteful (most of the shot falls to the ground), it works best on agile unpredictable targets (future science and technology), and momentary corrections only make things worse.

This is not to say that there is no feedback, but that the feedback has a different periodicity than conventional management. Each major sponsor meeting at the laboratory is a "shakeout" as we and our sponsors look at the work of the lab. We learn from these events. On a larger scale, MIT's own assessments of the faculty, in judgments about promotion or tenure, provide another source of evaluation and constraint. But the important point is that only by investing in the appropriate "unit of adaptation"—people, not projects—has the Media Lab been able to stay fresh and creative.

Churn. Churn is diversity along the time axis, ensuring that the individuals in the student body—the folks doing most of the work—change on a regular basis. While we administratively worry mostly about constipation—students who take a long time to finish—the lab still has a high average churn rate. Churn is the source of much of our vitality and creativity. It also helps keep our faculty fresh.

When we first began planning a European Media Laboratory, one of the initial surprises to our prospective sponsor was an insistence on university affiliation to obtain the students who would keep the place alive and hopping. One of the big reasons that corporate research labs tend to stagnate is that, after they have stopped growing, they do not have the churn of university research labs to keep them fresh. Many labs try to work around this with internship or cooperative programs, but these do not have the same effect as the longer-term involvement of a student in an academic program.

One of the reasons for this is that while doing the work is important, choosing the project is equally important. Most of the students' contribution to the creative diversity of the laboratory comes out in their search for a thesis topic, when they fit their own skills, perspectives, and interests to the interests and perspective of both the faculty and sponsors. Once the topic is identified, the students bring their impressive energy and skills to its execution, but the student contribution to the creativity and productive craziness of the lab derives from their search for thesis topics.

Fortunately, faculty are also an important part of this process. The worst sort of students at the lab are the ones who arrive with their own research agenda and are only marginally affected by the faculty and atmosphere of the lab. These are usually disasters for at least two reasons: first, their judgment is often immature (I know mine was as a student) and secondly, they are tragically immune to the midcourse corrections that are so important to bringing a project to fruitful completion points. Interaction and synergy, usually among students working with different faculty, generate much of the most interesting work of the lab.

To offer a somewhat stretched analogy, one may think of the lab as an ecology where students' minds are evolving new ideas on a continuing basis. The students are organisms, and the faculty are the genome. Both evolve, but the students are able to change and adapt much more quickly, while the faculty mutate and evolve more slowly. This makes for a creative, adaptable, but robust intellectual ecology.

Playfulness and risk. People coming through the lab often ask faculty and students: "You are paid for this?" This is not because the work does not seem worthwhile but because it seems like too much fun to be a "real job." Rather than commenting on a cultural attitude that work cannot be fun, I would rather focus on the spirit of playfulness that imbues the lab. Playfulness is characteristic of all advanced animals and (in a different fashion) of most creative and intelligent humans. And if you look through the project list of the lab, you can see playfulness through and through. Playfulness was also common at the AI Lab when I was there and in almost every other research lab where I have worked. It is a hallmark of places where people love their work.

Playfulness also comes from a tradition of engineering experimentation that is characteristic of, though not unique, to MIT. From Seymour's early work on LOGO, to the AI Lab's longtime insistence on working with incremental languages (e.g., LISP), to the whole style of "trying it out" in courses throughout the MIT campus, the experimental tradition has been a playful tradition.

At the lab, there are several additional sources of playfulness. One is the sense of safety engendered by the community and people focus at the laboratory. People afraid for their jobs and degrees are less likely to be in a playful mood; in all the labs where I have worked that I have seen "wind down," there was a marked decrease in playfulness (and creativity) as the sense of security and comfort was diminished. Of course, maintaining playfulness in a laboratory is complicated when the sponsoring organization is suffering and shrinking. It is hard to justify "play" when dividends are shrinking or front-line workers are being laid off. Though I will probably regret saying it someday, a quick end (with generous severance) to a research laboratory is often better than a gradual diminishment. Researchers at a downsizing laboratory tend to become narrower and less interesting; researchers moving from laboratory to laboratory often end up broader and more interesting.

At MIT, another source for playfulness is respect for what we call the "idea-let," which is a small unproven idea that can be explored on a limited time scale. People are more likely to be playful with two months of their life than with two years, which makes idea-lets into good mechanisms for experimentation. Part of Steve McGeady's lab at Intel Corporation has a policy of only starting six-month projects: after the six months, the project is either canceled or moved out, but the time commitment makes the risk low enough that people can be more playful.

The playfulness of the lab goes hand-in-hand with a commitment to high-risk research. Nicholas often tells sponsors that they are paying MIT to make the mistakes that their companies cannot afford to make. High risk means mostly making mistakes of one sort or another. But you have to play to win. One of the most useful and important skills for faculty is the ability to plan and manage so that mistakes do not derail students' theses. In most cases, something that does not work out should still have some interesting if unexpected results that can be made into a sponsor demo or a reasonable quality thesis.

This risk policy is also connected to the intellectual property policy of the lab. As mentioned above, the lab has the novel policy of granting access to all work to all sponsors. This means that if Company A funds project X at the lab, they also have access to project Y, which was funded by Company B, and likewise Company B has access to project X. Of course, companies have more immediate access and direct influence over the projects they fund directly, but access is shared among all of the sponsors in the long term.

Some sponsors have a difficult time with this policy, and the lab has probably lost much more funding than it has received because of our commitment to it. We have also lost some research faculty who have been concerned about non-U.S. access to the technology they were developing. But the policy is directly tied to the commitment to high-risk research since it provides a way, much like an insurance company, that individual companies can pool the risk of doing cutting edge basic research. Frankly, it also serves as a kind of character test for sponsors: A company will only sponsor the lab if it has enough self-confidence to not feel it needs an exclusive lock on technology to succeed.

Conclusions

This conclusion should be longer but it is difficult to draw together concisely because the Media Lab resists reduction to any single point. In each of the areas of form, content, and style, the Media Lab draws its vitality and quality from a constellation of different elements and points of view. In terms of form, students, research, and sponsors, each form centers around what we can see of the other elements of the lab being organized. In terms of content, our individual disciplines are distinct enough to make any disciplinary reduction moot; nonetheless there are common threads to the ways we think about problems and the way we pursue the things we feel are important. And finally, research styles are difficult to clearly define in the first place, and the style of the Media Lab is no exception. Elements of the style such as diversity and community or risk and commitment seem at odds in important ways, but it is their creative tension that makes the place work. Like the architectural systems that I described above, the Media Lab is a dynamic solution to many different sorts of constraints. I have tried to enumerate some of them and their significance; any attempt to recreate the laboratory will not succeed if it merely copies some features but does not have the flexibility or

courage to keep experimenting and changing. The lab, in some quiet way, is like a dynamic art piece to which we all contribute; like all such pieces, sharing it promises to yield far more than we expect.

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