From Trash Heaps to Toolkits and Chaos to Convection – Management and Innovation at Leading-Edge Design Organizations and Idea Labs

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My research at the MIT Media Laboratory has entailed close collaboration with many artists, technologists, and frequent interaction with managers at our corporate sponsor companies, affording a rare opportunity to work with and observe traditionally separate sub-cultures that do not often intersect. Contemporary design similarly inhabits a middle ground between art and engineering, as the designer's product should both work efficiently and make an aesthetic statement.

Although the work of a pure artist isn't necessarily directed by an application, it's nonetheless generally inspired by some kind of stimulus in the real world that spurs the artist to express him or herself through their medium. It's fascinating to trace the process by which an artist conceives of and produces a piece. Often some sort of random-seeming stimulus acts as a seed that crystallizes and grows into a beautiful production. Although the final outcome of this process often bears little relation to the idea that launched the effort, the generation and evolution of the initial concept is a critical step in the artist's production. I've recently seen some striking examples of this process through a collaboration with the well-known kinetic artist Michael Moschen, who meticulously documents the various stages through which his performance pieces pass as they develop. He generally begins with a fascination with particular shapes or by noticing the way in which something moves in the environment, e.g., a branch flapping in the wind or the way a piece of litter rolls down the street. This inspires him to realize some sort of simple sculpture or aggregation of objects, which he often builds up in his garden. He watches how this structure looks and moves naturally in the environment, occasionally tweaking it himself, usually for weeks or more. Then he makes another set of objects that he can physically manipulate and thereupon begins to practice intensively with these artifacts to develop his performance.

The process of design usually begins with a concept not necessarily generated by the designer. Unlike the artist, the designer is more often commissioned to produce something that serves a specific purpose. That said, designs that have the most impact involve breaking boundaries and seeing a particular function from a very different viewpoint. Accordingly, designers tend to create work environments that tap from and overlap various disciplines and approaches.

I've had occasional opportunity to collaborate with several leading design firms and visit them at their workplaces. One of the first things one notices is the way in which a design house has many artifacts scattered about, from which designers can evolve new ideas and design concepts. Not only their own products, but also interesting designs from competitors are displayed and made available to pick up and examine. IDEO, for example, has a full-time staff member in charge of acquiring and curating this gizmo collection; new devices are continually collected, announced through publications and online lists, and made available at a central location (generally purposefully located in an area of heavy traffic flow) for their designers to examine and even checkout as one would a library book. I've found stockrooms to serve a similar purpose; when in search of an idea or solution to a problem, wandering through aisles stocked with different kinds of

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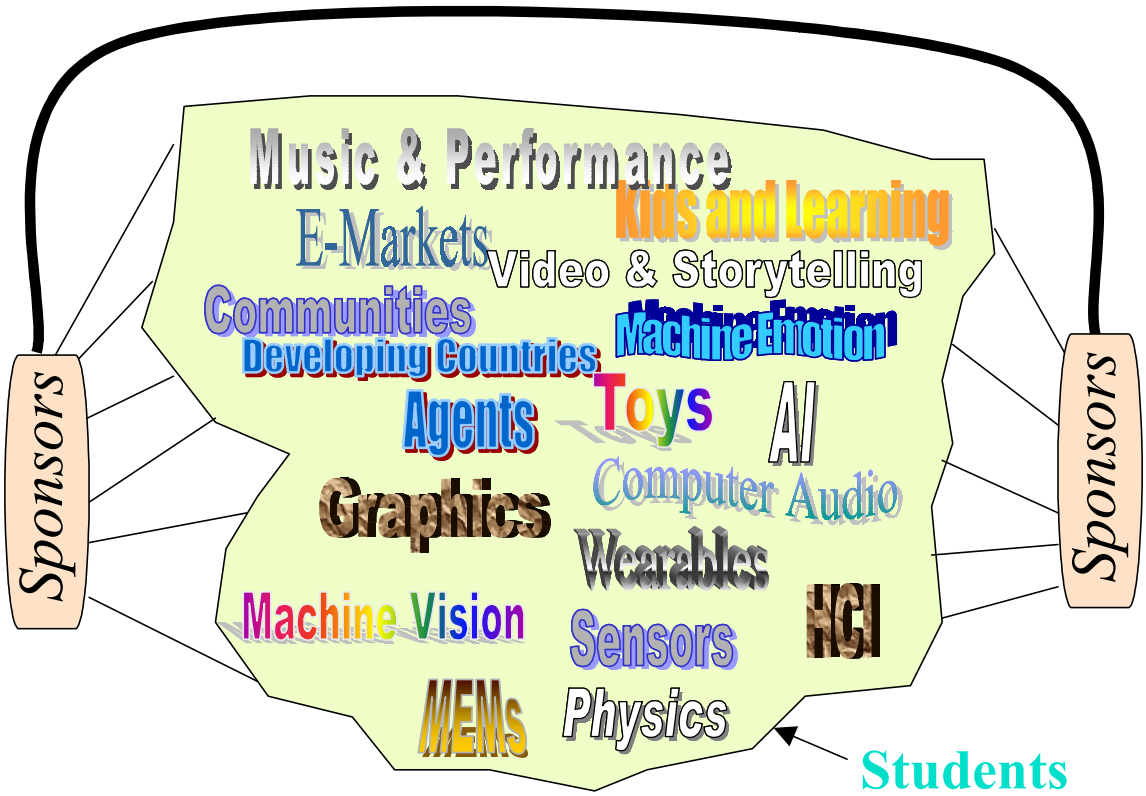
items and materials (the more categories the better) often provokes several ideas, often unrelated to the original purpose of the items on display. One unfortunate side effect to the rise of Internet retail is the shrinking and eradication of corporate and university stockrooms; the hidden cost in lost ideas isn't easily calculable.

Perhaps there is an analog to this "artifact" concept in the world of management via case studies. The tangible nature of the designer's artifacts, however, provide a major difference. Being able to pick up and manipulate these devices and items with your hands and to physically feel and observe the way they work engages something very primal in the human psyche. We learn with our hands – although one can study and understand a concept through literature and diagrams, physically engaging with an actual object produces a deeper understanding – it stimulates a kind of intuition that is critical to a designer.

A major trend in human-computer interaction research is what is termed "Tangible Interfaces"[1]. This movement has the goal of changing the dominant means of interacting with information; moving away from today's graphical user interface (GUI), where we manipulate visual abstractions projected onto a flat screen. Proponents at the Tangible frontier are trying to move the computer interface into physical objects that can be more naturally manipulated. Information is then represented through some kind of physical abstraction; the data or concepts connected to the object are then explored through physical manipulation, much as the way the designer handles artifacts to obtain a deeper understanding of principle and aesthetic. It comes as no surprise that some of the best practioniters in this field are also designers, or have strong empathy with design principles. The form and function of these devices connects to the virtual world as well; designers of tangible interfaces must also develop a behavior or mapping that works well with their physical artifact – hence the term "interaction design," has been recently coined; a term around which several new research and teaching institutes are named and/or themed [2].

To avoid problems of clutter, tangible interfaces need to achieve some degree of generalization. Although generalization is common in the GUI world, where we use a small set of nearly universal interface hardware for everything we do (e.g., keyboard, pointing device, display), it's less clear what types of tangible interfaces will win and become standardized across a range of applications. In some sense, the notion of generalization flies in the face of the tangible manifesto, which very much wants to unify the physical form of the interface to the intended application. A way out of this, however, may be to think of tangible interfaces as being parts of a toolkit. Some tools, such as hammers, screwdrivers and pliers, are quite general, and work for a variety of applications (although service some better than others). In contrast, tools such as pipe cutters, tape measures, or stud finders are more specific and do a very good job only in a narrow application niche. In the world of tangible interfaces, we've yet to define the tangible toolkits, which are a topic of current research [3]. One can conceive of tangible toolkits for management processes, enabling physical exploration of organizational dynamics, a company's fiscal or logistical status, etc. As tangible interfaces provide a means through which information can become physical, this paradigm could offer managers a means of tactilely exploring possibilities, much as in the way a designer engages with artifacts.



Structure of the MIT Media Lab as Innovation through Intellectual Diversity

Toolkits, in general, have another purpose that is especially appropriate for innovative organizations such as design labs. They coherently encompass a set of capabilities, enabling people unfamiliar with the underlying technology or set of concepts upon which the toolkit is based to rapidly assimilate the necessary principles and basic experience needed to begin applying the component tools in their work. Toolkits can include anything that's relevant; they range from physical objects through electronics hardware to software and manuals. Toolkits go beyond the collections of artifacts that design labs curate; they enable designers to engage with the principles driving the devices and rapidly assimilate them. Studies of corporate innovation [4] have recognized the importance of toolkits for stimulating the creative process; toolkits can enable so-called lead users to solve problems in entirely new ways. Oftentimes, the breakthroughs come when the tools are used in ways they weren't intended. One of the main challenges in technology innovation is to determine what the "killer app" will be for a particular development; history abounds with quotes from inventors expounding on what their invention will enable, only to be dead wrong when their brainchild succeeds for an entirely different reason.

At the MIT Media Lab, we've created many different such "toolkits" for various groups and sponsors to adopt in their research. These toolkits have included several embedded computer platforms, different types of sensor packages, and software suites. They frequently are made to support our own work, but by packaging the most successful of our devices and making them available to a larger community we're able to seed innovation across a wide range of disciplines.

Indeed, much as in the way that design houses tend to encompass talent spanning many different specialties, the Media Lab is home to an extremely diverse set of people who hail from very different backgrounds. Several attempts have been made recently to draw organizational charts for the Media Laboratory, and all of them have failed. The depiction of a chaotic blend of disciplines given in the above figure is perhaps the most accurate thus far. Such chaos, in my opinion, is a crucial part of how these extremely interdisciplinary organizations innovate. Much as how the scattered artifacts in the designers' collection or the diverse items on the shelf of a stockroom can stimulate innovation, the mix of backgrounds, expertise, and goals deriving from such a hyperdiverse group can produce frequent jolts that keep the participants on an edge – people who survive in such an environment naturally move to the boundaries between disciplines where new fields of inquiry can sprout.

Left on its own, however, such a diverse group can compartmentalize. Several components are important to keep it mixed. At the Media Lab, toolkits play part of this role. A group can encapsulate a sliver of its expertise into such a toolkit, which can then be used by other groups for entirely different (and quite unanticipated) applications. Looking at the figure, I placed the more technical, engineering-intensive groups at the bottom and the more content-related groups near the top. Thinking of this as a pot on the stove, the toolkits are the transportation mechanism for a convective process of learning and communication. Devices produced by the engineering groups propagate up to the content groups, where they are pushed into all different kinds of unusual niches. These applications filter back down to the engineering groups, who become inspired by the way in which their inventions were adopted, stimulating them to innovate further and the process begins anew. Of course the flow doesn't need to begin at the bottom – just as artists can be inspired by a piece of technology, the technologists can be inspired by an expressive work. The important thing is that a set of processes exist by which knowledge and innovation can be transported across intellectual boundaries.

Other factors play important roles in breaking disciplinary barriers at the Media Lab. The demo culture is another important route. The Media Lab is very much a "show me" environment. Although students are required to drill down to achieve analytical or reflective depth in their thesis work and publications, it is mandatory that they produce some kind of encapsulated "demonstration" of their work along the way. This need not be anything like a final product (and is generally far from this), but it must somehow embody the core principles of their research. The goal is to enable them to powerfully and simply convey their directions, concepts, and results to a general audience. Having several groups of industrial sponsors visiting each day keeps pressure on the demo pipeline, and the two very large sponsor meetings/tech-festivals that we host each year are hard deadlines that require these demos to manifest (not only because of the convening sponsors, but due more to peer pressure from other students who are demoing their work; these meetings are the Olympics of Media Lab culture and nobody wants to be left behind). The demos, however, also serve an important internal function in enabling groups arising from different disciplines to easily show their work to one another and spread concepts about.

Especially in working with artists, a demo can be critical; just as a designer handles tangible artifacts to better "grok" them, an artist doesn't necessarily get excited by a circuit diagram or software specification. Seeing a part of the concept run in a

demo, however, can make a deep impression. I've heard such stories from colleagues also working outside of the Media Laboratory, for example at Disney Imagineering. Disney is a company run by artists, and to succeed in any kind of technical project there, demos are critical to gain corporate understanding and support to see the work go further.

Still other factors help to mix things up at the Media Lab. The industrial sponsors themselves are perhaps another source. Sponsor groups frequently come through on daylong "tours", spending anywhere from a half-hour to an hour with various groups (they're depicted in the figure as connecting across the entire lab, which is often the case, even for companies that you'd least expect to be interested in subjects significantly displaced from their core mission). The best of sponsors can act like pollinating bees, picking bits up from some groups and dropping them off in others, often leaving a nifty idea of their own behind too.

Perhaps the most important factor in keeping an organization like the Media Lab together is our students. I've depicted them in the figure as the amorphous material that constitutes the core of the lab. They're absolutely critical in this mix. Although I've used the term "artist" and "technologist" as separate quantities in this text, each individual is a weighted vector sum of both, some more one way than the other. We tend to bring in students who are in the middle, able to understand something of each perspective. Even in the cases where they are firmly at one end or the other, their colleagues in the middle serve as conduits, infecting them with artistic outlook or technical concepts. Although students belong to particular research groups, their social structures respect no group boundary. They freely associate with one another, and, of course, talk about their work. Being young enough to keep open minds, they'll take what they've seen in one group (again, often by catching the demo), establish an impromptu collaboration with a colleague elsewhere, and produce a cross-genre hybrid that's quite unanticipated. Many of our best projects get started that way.

Our classes are one way in which these student collaborations can get started (especially when doing a class project – many of the Media Lab classes are "atelier" in nature and require the students to produce some kind of finished work or demo), but they also occur spontaneously, probably much more often. Although classes in general are meant to provide students with intellectual toolkits, our classes can be quite extreme here, as we can have students coming from both art and technology backgrounds in the same session. The idea, at least in the many overview classes that we provide, is to rapidly get them the capabilities they need to begin using the tools and start innovating. For example, in a semester we'll get an artist using a machine shop, doing basic electronics, programming microcontrollers, etc., bringing them across the border of fear and giving them enough understanding to freely and confidently experiment. Likewise the technologists, within the course of a semester, can learn how to put a piece of electronic music together or program expressive graphics. Granted, not everybody has a hope of producing quality music or becoming a crackerjack engineer, but we do succeed in giving the students enough common ground to talk to one another, establish mutual respect, and absolve some of the apprehension and mystery associated with a formerly alien mode of working and thinking.

Another critical aspect of the Media Lab's environment is the policy of granting free intellectual property (IP) rights to all full sponsors. Independent IP relationships between sponsors and research groups can establish knowledge barriers around particular

projects and block the convective flow of information that is so important to the culture. An interdisciplinary organization like the Media Lab relies on free exchange of information across groups and projects – it's very much an opposite environment to that of an incubator.

The philosophies and approaches behind organizations like forefront design houses and interdisciplinary research institutes like the Media Lab have attracted considerable interest in the corporate and academic communities, and there's a drive of sorts now to export these ideas into other cultures. IDEO, for example, offers corporate seminars on their creative processes and design. The Media Lab is likewise budding copies across the world (e.g., the Media Lab Europe in Dublin, the Media Lab Asia in India, and others in more formative stages).

Even though the frontier here is expanding, no organizational structure lasts forever and interdisciplinary organizations, in particular, are by nature unstable. They can dissolve along several pathways as they grow and evolve. One is a drift towards specialization. Even though the physicists that you first hire into a nascent interdisciplinary team can talk with the musicians and graphics artists (after all, that's why they came in the first place), the physicists that they hire may be less inclined to cross boundaries, and the physicists that they hire get even more specialized. Eventually you get a little physics department that, although perhaps a bit weird by mainstream standards, splits off by itself to do its physics. In the best of cases, this is due to a success; a part of the interdisciplinary group has indeed invented a new discipline, and splits off to explore it full-tilt. In a less positive scenario, the split is due to a communication breakdown resulting from organizational drift.

Another mode through which such interdisciplinary organizations can fail is quite the opposite. Here, the participants can't effectively gel productively, and drift off toward a fluffy vacuum, exploring problems in the cracks between their collective expertise that are irrelevant, uninteresting, or perhaps even trivial when viewed properly. As they are often reaching beyond their bounds, they aren't always effectively grounded in reality. The people working in such an environment must be sufficiently deep in their own disciplines; very much a part of their particular intellectual community, while still able and motivated to reach across the table and commune with their colleagues from different callings and have a good sense for relevance.

It has been said [5] that the maximum size of a functional organization is roughly 150 people; if it gets much larger, they lose familiarity with one another and no longer function as a group. Interdisciplinary organizations may have even stricter quotas – not only do participants need to engage at a human level, but they also need to understand each other across wide conceptual gulfs. Providing effective management mechanisms to dynamically tune and adjust these organizations such that they optimally innovate is a challenge that becomes ever more important as these "idea factories" propagate and grow.

References

[1] Ishii, H. and Ullmer, B. "Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms," in Proc. of the CHI '97 Conf. on Human Factors in Computing Systems, New York: ACM Press, 1997, pp. 234-241.

[2] For example, see the Interactive Design Institute in Ivrea, Italy: *http://www.interaction-ivrea.it*

[3] For example, see Ullmer, B., "Tangible Interfaces for Manipulating Aggregates of Digital Information," Ph.D. Thesis, MIT Media Lab, expected September, 2002.

[4] Von Hippel, The Sources of Innovation, New York: Oxford University Press, 1988.

[5] Gladwell, M., The Tipping Point, Little Brown & Company, 2000.