Sophia J. Wang, 1/1/2025

Reflections and Recommendations for Innotech

Core areas of development for Innotech

- Incentivizing team members to be as motivated as team leaders through a culture of curiosity and ownership
- Improved navigation through the supply chain
- Machine utilization, frequency and use-cases
- Transition from production to design through fundamental expertise
- Formalized project specifications and market research prior to starting[1]
- Rigorous design reviews from an external board (within or external to team)[2]

A roadmap

1. **Funding**
2. **Fundamentals: transition to knowledge creation**
3. **Curiosity-driven culture**
4. **Accountability**
5. **Network aka seeing inspiration everywhere**

1. Funding

Most academic labs draw from a few sources of funding: government grants (American: NSF, DARPA, NIH), cross-university collaborations, and corporate sponsorships.

Case study Media Lab: what made the Media Lab successful was

(1) its explicit public-facing model aka communication with the public that broke traditional academic circles of journal publications, conferences, and advisory boards. The Lab has a phenomenal media team that gets research featured everywhere, from news agencies to design magazines to museums, produces videos, and hosts demos that match 2000s Apple product unveilings in finesse. The Lab is obsessed with presentation[3],

---

[1] Accountability is important. GoogleX, the bold Moonshot factory for Alphabet known for the space balloon and self-driving cars, reviews projects every year and explicitly "looks for reasons to kill the project." (TedX talk) Astro Teller, GoogleX's leader, says "Enthusiastic skepticism is not the enemy of boundless optimism. It's optimism's perfect partner."

[2] At NASA, we would find folks from outside our department or even hire consultants for our big design reviews to get an objective board opinion.

[3] Example: Transform by Tangible Media Group, my former group

sometimes to the criticism of being overly "bells and whistles". An old saying is that at the Media Lab, font is as important as any research decision.

(2) its funding scheme, which accepts funding on general themes rather than per-project/per-group. Of course, some groups have directly sponsored corporate research, but the overall pool which all groups at the Media Lab access are based on themes. Sponsors would then be connected with researchers on related projects.

Innotech can increase its public communication, especially in traditionally non-technical spaces, perhaps veering into showmanship, to attract investors as well as be in constant discourse with the public. Innotech can consider a similar model of funding by theme to relieve the pressure of babysitting and appeasing sponsors and instead give the team more latitude to focus on research.

2. **Fundamentals: transition to knowledge creation**

(1) *Return to fundamentals* to create fundamental research. Currently, our team lacks the expertise of fundamental physics, electronics, and chemistry to produce novel research. One solution towards this, beyond skill-transfer from foreign experts, is creating a curiosity driven culture (next section).

(2) *Maximize machine's potential* beyond production and standard prototyping. Here are a few, off-the-cuff examples, that demonstrate how a deeper understanding of the underlying strengths of every machine enables better, Zero to One, research. I encourage this identification for each machine in the repository as an exercise for the team. Incredible machines, but underutilized in scale and purpose.

- Laser cutters: Beyond making signs, laser cutters are precise engraving and cutting machines at a fraction of the cost of high precision, heavy-duty machines like wire-EDMs. Take advantage of that precision, as well as the CO2 laser. Example: you can induce graphene on a laser printer (wild!) to create wearable devices simply by purchasing Kapton tape (very commonly found in makerspaces as a type of electrical tape) and etching – of course, with lots of fine tuning of power, speed, and DPI. Further, you can make very fine electrical circuits on laser-cutters, handy for long, winding traces needed for, say, in-house RIFD tags.
- Vinyl cutters: Good not just for making stickers, but for etching on thin, flexible surfaces. This makes them effective for making wearable devices using flexible circuitry.
- Zund: This machine's ability to crease and cut gives way to strong Kirigami structures with thin aluminum sheets (see Alfonso's work). This allows for the

design of novel folding geometries that can be used in construction across industries.

- Wire EDM: Micromachining allows for production of custom machine parts and even novel geared drives, motors, etc.
- 3D Printing: Even 3D printing can be used in a fundamental way! An example is with compliant mechanisms that do without traditional electromechanical parts (springs, gears, etc.), instead taking advantage of flexures for the same mechanism. Compliant mechanisms have been used to make open-source microscopes[4] that are (almost, save the optical glass) entirely 3D printed. Here, you can use a 3D printer to design 3D flexures that otherwise could not be fabricated subtractively, creating your own mechanisms for control systems instead of using complex electromechanical systems with several actuators and stages.

note: Supporting fundamental research is about buying time, as these developments operate on a much longer timeline than application-layer or even integrated systems. Needs a separate funding structure

3. Curiosity-driven culture[5]

Create a culture where the team is up to date with technological trends and state-of-the-art, while consistently sharing their findings with the group and having conversations:

- Paper Review Club (weekly/biweekly): sharing exciting papers in Science/Nature/IEEE (academic), articles from Wired, MIT Technology Review, etc. (academic & corporate, public-facing), TED Talks (public-facing), Hackaday/Maker blogs[6] (these are hardware sites, but I'm sure there's equivalent software ones), and more. These are just sample forums engineers monitor, but this exercise is all self-guided, so any material works. If anyone is especially excited about one topic, they could ask the group to read a paper (usually these are no more than 10 pages) over the course of a week, then gather and discuss. This is a regular practice in Silicon Valley AI companies, where the company will assign papers in reading clubs

[4] Which is an incredible feat of engineering given microscopes historically are made using heavy, precise micromachinery with tight tolerances to reduce vibrations when looking at a sample.

[5] Creating a curious environment incentivizes learning and out-of-the-box thinking that crosses disciplines. The Media Lab succeeded because it valued Furbies (yes! the animatronic toys) as much as Quantum research.

[6] These forums are great because although some projects are made by experts, most are from hobbyists that navigate with the same if not less professional machines than those found at SFL to create extraordinarily innovative projects.

– a practice just as important as stand-ups. Most importantly, this encourages people to be curious inside and outside of their domains on their own time. Most of engineering is knowing where to make theoretical connections across disciplines. At the research labs I've worked at, we would share papers ranging from how an octopus dreams to quantum spin resonance – whatever got people excited that week.

- Volunteer basis of team members leading internal workshops[7] on topics they're passionate about. Whether that's on how image generation models are now used by data scientists to bolster small datasets or how geared drives are designed.

4. Accountability

Project ownership for every person, regardless of rank, on the team.

- At CBA, every person "owned" a topic. For example, one researcher managed the machines domain, another robotics, another numerical simulations. Each researcher had to understand the state-of-the-art in the field as well as handle relevant sponsors (tours, research talks, demos). During my undergraduate, I directly interfaced with the head of Toyota Research. Although the research was stressful, the trust and responsibility placed on me provided me with the necessary faith and energy. This practice developed a group mentality of expertise, a name and face for who in the lab we could look towards for every domain, as well as a culture of excellence across every member.

Currently at Innotech, there are knowledgeable, more expert people as project managers, but the expertise rarely carries one layer down as analysts are spread thin across many projects without opportunity to develop depth of transferrable knowledge and importantly, have a concrete sense of ownership.

5. Network aka seeing inspiration everywhere

[7] This practice is seen most notably at the best restaurants in the world. Eleven Madison Park founders have a phenomenal book called *Unreasonable Hospitality*. In it, they describe a program where workers would give weekly voluntary talks before the team about a topic they were passionate about. One team member recounted the entire history of the block the restaurant was located, which in turn gave guests a contextualized eating experience. Another taught a lesson on yeasts used for beers, another on napkin etiquette, and so on. That was the culture that created the No. 1 restaurant in the world in 2017.

Expose Innotech to as many domains as possible, especially those not inherently technical[8].

- Innotech residency programs where an international (or domestic) call for leaders in various disciplines, not just tech, can come to SFL/Drive for 1-2 months and work on their ideas with our team, learn from our team, but ultimately with as few guidelines as possible, a carte blanche.
    - At CBA, we would host residents. Sometimes these residents would be machinists, physicists, biologists. Other times, they were artists, musicians, and more. They would build in the lab, collaborate and learn with us. We'd always come out with a fresh idea and perspective. This exchange is what Neil likes to refer as: the artists teaching the engineers how to build; the engineers teaching the artists how to design. Practically, this also creates better market understanding.
- Engage with the open-source community through conferences and online forums. This group is creative and willing to share/co-develop by nature.
- Engaging in conferences and trade shows

for Bhutan Creating a National Academies to connect technical leaders across Bhutan (see: the American National Academy of Sciences, the National Academy of Engineers, the National Academy of Medicine, and more). Usually, the top academics and industry leaders are nominated in a highly selective process. The academy meets annually. Starting to create this interconnected technological community in Bhutan, even if its nascent, is a gathering point for talking about ideas and getting everyone in one room together.

[8] One project I had in mind, had my time been longer at Innotech, was collaborating with the National Galleries to use the Artec scanning machines to preserve cultural artifacts by creating a 3D digital scanning platform. Depending on the success, this could spin off as a product for museums on a platform free from Artec (expensive, unwieldy, large CPU), see Quentin's Fab final project. The point being, engage engineering with as many disciplines as possible, driven by curiosity.