
When Engineering Isn't Enough

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General Engineering with a Concentration in Product Design

Engineering Better Medicines

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Grand Challenge Focus

A middle school student answering the question "what do you think you'll study at college?", I was quick to cross medicine off my list. I believe my exact words were "I don't want to do anything that involves poking people." My disinterest in medicine remained largely unchallenged until I interned at Boston Device Development, a small product development consultancy in Newton, MA. As a college junior looking to develop experience in mechanical design, BDD's focus on medical devices was just the context for my work. As that summer progressed, I began to realize that medical devices are fantastic design problems because of their engineering challenges, human factors, and business needs.

The experience reaffirmed my decision not to become a surgeon, but made me reconsider the way I viewed medicine, how innovations come to market, and how many opportunities there are to make better products. Undoubtedly it was this experience that led me to work with DePuy Synthes Mitek Sports Medicine for my senior capstone project. Our year-long project was to identify gaps in DePuys' portfolio of devices, consider the market opportunities and unmet needs of surgeons, generate new device concepts, and ultimately build a functional proof-of-concept. Because of these experiences and my hope to work on similar projects after graduation, my GCSP portfolio will focus on "Engineering better medicines."

Story

When I arrived at Olin in the fall of 2010, I was set on obtaining a degree in mechanical engineering so I could pursue my passion for racing cars and automotive technology. I defined engineering as the application of math and science to create technology, although I never really considered *why* we create new technologies. For racing cars, the why is simple: go faster. Olin's unique emphasis on human-centered design helped me consider the "why" for other domains, from designing mobile applications to help people use public transportation, to thinking of products that appeal to urban biking enthusiasts, to developing a sustainable product for the home

My new-found fascination for thinking about *why* and considering the context of engineering solutions led to changing my major from Mechanical Engineering to Engineering with a concentration in Product Design. Math and science can create technology, but creating a *product* requires knowledge of industrial design, human factors, and business analysis, too.

In studying a mix of engineering and design, I believe my four years at Olin have aligned well with the Grand Challenges Scholars Program. While there are countless factors that have contributed to me being where I am today, I would like to talk about three key experiences that particularly resonate with GCSP.

The Olin Triangle

When I came to an admissions event at Olin, one of things I heard about was the "Olin triangle."

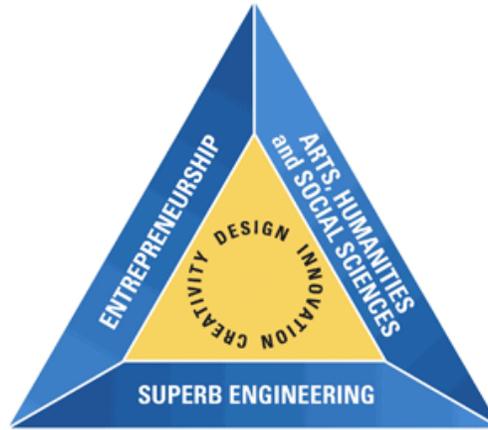


Fig. 1: The Olin Triangle

It did a decent job of telling me how Olin's curriculum was different from other schools, but I honestly didn't care about the entrepreneurship or the humanities. I considered myself a "well-rounded" student in high school, but my experiences in STEM and the arts lacked integration. I suppose I never had a project that needed business, humanities, and engineering knowledge to find a solution. Olin changed that by throwing me into open-ended problems with no clear definition of what solution I should make.

User-Oriented Collaborative Design is a required design-thinking course for all students. This was one of the longest projects I worked on at a Olin and was one of the least technical. The project goal was to come up with a product idea that could have meaningful impact on a given user group. The course wanted teams to think about the problems facing people and what products could change their lives. Teams did not build working prototypes or do any traditional technical work. Instead, we spent time trying to understand people. It sounded so simple in the course description, but my team and I struggled for a long time with our user group.

"People who ride bicycles as their primary means of transportation." Why do they ride bikes? What motivates them to keep biking day after day? Is owning a car just too expensive or inconvenient? Isn't biking in the city dangerous? Is staying fit worth being at the mercy of the weather? These were questions my STEM education had not prepared me to answer! Worst of all, the course instructors did not have any answers for us. It was a seemingly-endless spiral of interviews, debriefs, and discussion.

I could go on about UOCD for quite some time, but that's a story for another day. After weeks of frustration, we started to understand who our user group was. We rode through the city at rush hour to feel the excitement they feel. We hung out with them to feel the camaraderie they do. We started to see why they did what they did. Once we understood that, we could start to come up with meaningful ideas. Our product concept (see Figure 2) actually got some nods of approval at our final presentation! Considering how far behind we seemed at the start of the semester, this was an incredible achievement for the team.

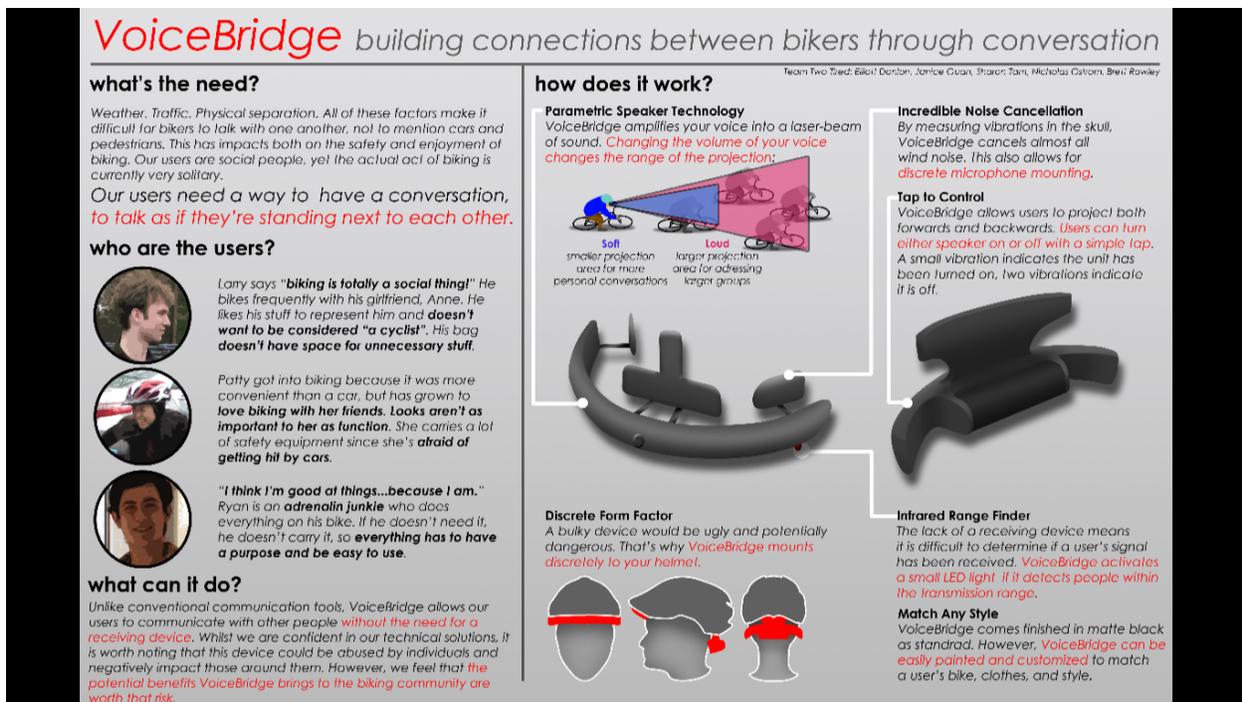


Fig. 2: Product Poster from UOCD - outlines the user, the need, and our proposed solution. VoiceBridge is a wireless communications device utilizing parametric sound waves so that bikers can more clearly communicate with those around them. Think of it as a directional megaphone.

This single project sparked my passion for design. Figuring out how best I can change someone's life was a much more exciting problem than any problem set I ever solved. I started completing my technical background with design experiences. When declaring my major, I said my goal was "to graduate with the tools to not only answer how something can be accomplished, but what is worth accomplishing."

Two years later, I believe I have done exactly that. In my final year at Olin, I had the chance to work on another UOCD-like project (Integrated Product Design, IPD). Over the course of a semester, teams would identify a user group and design a product for them. Our final presentations would not only include a visual model, but also a functioning prototype and a business plan. Of course it was challenging, but it was one of the most satisfying projects I have ever worked on. Two years earlier, a professor had cast doubt on my understanding of design thinking (with good reason). At our final IPD presentation, that same professor told us he believed we were really onto something (see Figure 3).



Fig. 3: Assorted IPD work, including engineering breakdown, working prototype, and marketing poster. Tapping the sponge wireless turns the faucet on or off. This control helps users save water without radically changing the way they wash dishes

Hearing that was one of the best moments in my Olin career. Not only had I come to learn what the Olin Triangle really meant, but I had embraced it! UOCD, IPD, and course like them helped me synthesize three seemingly-disparate domains. It is this love for interdisciplinary thinking that led me to my first internship, my senior capstone project, and my GCSP focus.

Boston Device Development

I was looking for an internship that would allow me to explore the relationship between design and engineering in the real world, not a classroom. BDD was a perfect fit because they were a small, new company. With four mechanical engineers and one industrial designer, it was easy for me to bounce back and forth between teams. Unlike a "regular" startup working on a single product, BDD has 3-5 projects at any given time. This enabled me to not only work on engineering and design problems, but also work in different domains. One week I was working on a testing fixture to send to a manufacturer in China. The next week I was conducting stress-testing and analysis on a finished prototype. Another week I was brainstorming possible configurations for a device docking station. Each project was working with cutting-edge technology on a crazy timeline - it was like working for multiple startups at once!

There was an interesting experience in my first week when the whole company (all 8 of us!) sat down to discuss how we were doing. A couple of years old and moving to a new office, we wanted to reflect on how the company felt we were doing in our mission. Not only was "the intern" involved in this discussion, I was also able to offer a lot of advice from my other startup experiences. As a member of the Foundry (Olin's student-led entrepreneurship organization), I helped organize talks and events with startups on campus. I had attended several conferences and skillshares. I made a lot of great friends in the community, too. BDD appreciated my insights from

"the other side" of the startups we were working with and how best to meet their needs.

As I mentioned earlier, it took some time before I came to appreciate medical devices as more than just context for my work. Not only were there serious technical challenges, but human factors and business plans played big roles, too. How can we make sure the device is effective, safe, and comfortable to use? How can we keep it affordable, reliable, and compact? At times it seemed like there was no way to meet all the constraints!

Consider the following product, for example. The original prototype given to BDD had a trigger that needed to swing both forwards and backwards. It worked reasonably well and refining that engineering wouldn't be too bad. Then we picked up the prototype and simulated inserting it into a patient. Pushing a trigger away with the back of your fingers while keeping the device stable was almost impossible! Human factors and robust engineering were at odds.

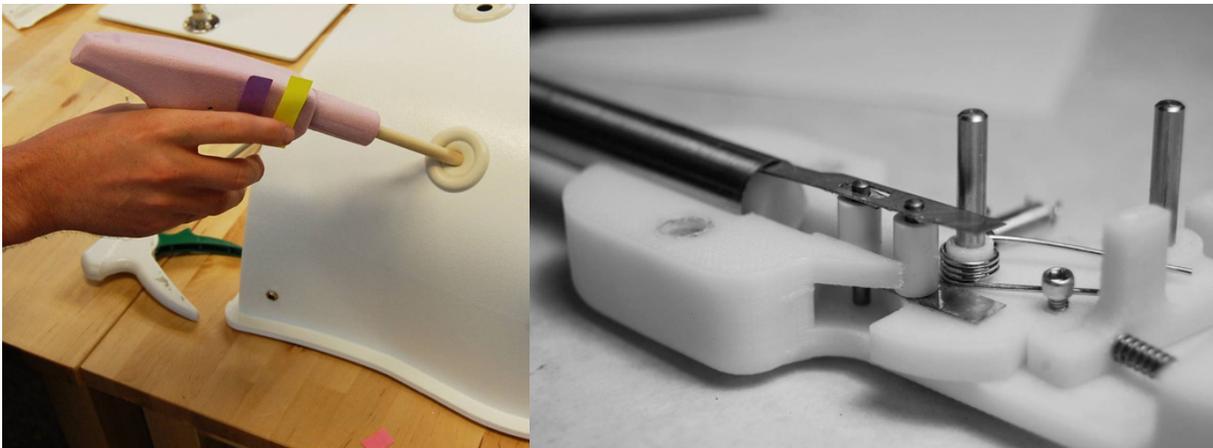


Fig. 4: Left - industrial design model to evaluate human factors and comfort. Right - close-up of a prototype mechanism.

Alternative designs that required a single squeeze of the trigger were possible, but technically tricky. Our early prototypes kept jamming and breaking. The designs became more and more complex, more and more expensive. In the end, we had to compromise. The device needed to work

well, but surgeons must be comfortable using it. If that meant more expensive machining and more complex parts, the cost will have to suffer accordingly.

This why I love product design: sometimes there is no single, "best" answer. You have to weigh the consequences of different actions and make a judgement about what is "best." It can be arbitrary and ambiguous - I thought engineering was supposed to be clear cut! BDD helped me become more comfortable with ambiguity and compromise. It pushed my design and engineering skills to new levels. It definitely put me on the path to engineering better medicines, too.

The Collaboratory

"People just don't get Olin until they come here." There is something unique about Olin's community culture that is difficult to define. The autonomy, passion, and collaboration amongst students and faculty are better observed than described. That's why the Collaboratory - Olin's method of engaging with other institutions - tries to engage visitors with the community. Olin has a unique pedagogy, but the foundations for its success lie in the campus culture. If a visitor comes from a radically different institution, it becomes essential to discuss Olin's community, as well as its curriculum.

For the past two years, I have worked for the Collaboratory as a student liaison. The position originally did little more than run tours, but has since grown into an important lens for the student experience. The liaisons offer insights into how students view the curriculum. We can critique what works well or not so well. We can reiterate what the faculty say, but from our own perspective. Visitors frequently comment on how the liaisons demonstrate passion for the college and add credibility to what they see and hear.

It shouldn't be surprising that I enjoy talking about culture and context. My parents are both originally from the United Kingdom, moving to the U.S. in 1984. My middle/high school was founded by mostly Turkish faculty and I had the chance to spend 19 weeks in Turkey over four years. My first trip was in 2005, spending 6 weeks with a family in rural Turkey who didn't speak any English. As a 14 year old, it was a tremendous immersion experience. Ever since, I have had a passion for travel and learning more about foreign cultures. The language barrier in Turkey helped contrast what cultural norms are different and what are the same. Religion, education, and social stratification can be very different. A love of sport, music, and food tend to be more constant.

The Collaboratory gave me an opportunity to continue learning about other countries while also reflecting on my Olin experience. Every visitor asks questions about the college and my work as a student. Not every guest agrees with the educational assumptions behind Olin. "Aren't you missing a lot of technical content?" "Don't group projects make it easier to avoid work?" "It seems like you spend a lot of time not doing engineering."

Answering these claims can be tricky. I wish I could just roll my eyes, sighing "you don't get it, do you?" Then I remember the whole reason I work for the Collaboratory is because people

don't get Olin until they come here and see us in action! So in replying, I try to share some of Olin's cultural context and contrast that to other schools or countries. For example, in regards to content: "it's true that Olin does not teach as much technical depth as other schools, but there are very few 'single-domain' problems left. The problems of the future require familiarity with many different fields." I could also share my father's experience as a young engineer in Europe or the economic context of a new engineering school in Brazil. Reframing Olin through different cultural contexts is a powerful communication tool I have come to rely on.

Every new telling of the story reveals new insights both about my experiences and about the background of our guests. I certainly would not be able to articulate my Olin experience as well as I can without the Collaboratory. Listening to the problems facing innovation at other schools also helped me appreciate some of Olin's unique qualities even more. When a visitor had doubts about part of Olin's curriculum, our discussions helped me think about ways to make Olin better. The insights that have come from these open dialogues are some of the most rewarding things about my time at Olin. Olin is an unusual place and I think it's important to be able to communicate that to others. This has also helped me better understand my own experiences as a student and recognize "defining" moments in my educational career.

Post-Olin

Thinking about my four years at Olin, it seems as if a myriad factors have led me to where I am today. Courses, conferences, professors, and peers have all had their impact on me. Instead of trying to synthesize hundreds of different moments together, I chose to focus on three distinct experiences. I believe these experiences represent some of the key insights from my Olin career, but also help weave my Olin story together.

Olin's interdisciplinary curriculum exposed me to design and sparked a passion for product design. My work with the student entrepreneurship group introduced me to Boston Device. BDD gave me the chance to explore the relationship between design and engineering and also interested me in medical device design. The Collaboratory provided a forum to reflect on everything I was doing and share those insights with others. All of this makes me appreciate the breadth of experiences I have had at Olin and I'm excited to carry them forward after graduation.