

# Engineering for Social Impact

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*Grand Challenges Scholars Program (GCSP) Portfolio*

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Grand Challenge Addressed: Ensure Access to Clean Water

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## Introduction

At Olin, I have learned to explain that engineering is about *technical problem-solving*. Moreover, I whole-heartedly believe that as an engineer I bring together systems, technologies, design, and people in a way that addresses real problems. And I love doing so! I also believe that this type of technical problem-solving is an effective way to address the real problems faced by people living in developing nations – access to clean water, sanitation facilities, communication systems, infrastructure, as well as machinery and tools for agriculture and other income-generating activities. I entered engineering with the intention of participating in this kind of engineering in international development, and I have tried to use my time at Olin to prepare to work effectively in this context.

In addition to my Grand Challenges Project in the area of providing access to clean water, I have also gained experience in international development by my participation in *Affordable Design and Entrepreneurship (ADE)*, a class dedicated to social ventures. In *ADE* I have worked on a series of small machines (graters and presses) designed for small-scale gari-producers<sup>1</sup>. Although not in a specific challenge area, these projects are also deeply connected to several of the GCSP components, and have played a large role in shaping my understanding of engineering in the context of international development.

## Grand Challenge Problem Project: Provide Access to Clean Water

In Spring 2011, I worked on a research project developing a rainwater collection system for use in long-term refugee camps in Haiti. In these camps, sufficient drinking water for survival may be provided, but access to additional water for cooking, washing and cleaning is a persistent problem because the camps are not constructed with infrastructure to support a permanent population. Collecting rainwater allows residents to save the most highly purified water for drinking and use slightly lower quality rainwater for important secondary uses.

Using seasonal rainfall data, we calculated storage capacity needed to create a significant increase in supplemental water while also keeping in mind feasibility of such a construction (e.g., a very low cost, locally available materials, a small footprint, which is important in crowded camp conditions). In addition, one of our rigid constraints was that our design could be fabricated and repaired on-site. Therefore, we decided on a simple system built entirely out of plastic sheet, which is generally imported to disaster areas in large quantities for temporary shelters and repairs<sup>2</sup>, and can be easily cut with hand tools and welded together at low temperatures.

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<sup>1</sup> Gari is a shelf-stable product similar to cereal that is made out of the staple-crop cassava (also called yucca root).

<sup>2</sup> Plastic sheeting is so ubiquitous that USAID even stockpiles it near areas likely to be affected by natural disasters. See <http://blog.usaid.gov/2012/03/pre-positioned-plastic-sheeting-hastens-recovery-in-madagascar/> and <http://www.usaid.gov/news-information/press-releases/bureau-democracy-conflict-and-humanitarian-assistance-chief-susan-g>

Many engineering projects and products are derailed when they need repairs that cannot be done with local facilities and materials, with the result that the projects must be discontinued and products are rendered unusable as soon as they break. My goal is to design sustainable systems that are feasible not only in initial implementation stage but also in long-term use. As well, another benefit of using locally manufactured and repaired materials is that the process and products in question now can serve a source of local employment. In the experiences following this one, I have tried to integrate these concerns for materials and manufacturing processes to allow for product fabrication and repair within the context these products are actually used.

This project was my first significant experience in international development. Through this semester-long project, I began to learn the skills, processes, and understanding necessary to work in foreign contexts, and to design for underdeveloped parts of the world and areas in crisis. Most importantly, I have gained a valuable understanding that learning about the specific context (e.g., culture, environment, etc.) prior to developing technological innovations is important to success. I built further on this understanding during my participation in *ADE*, and I believe I will take these lessons with me in the future regardless of where I end up.

## Interdisciplinarity

Olin's curriculum, which permeates all aspects of the College's culture, is designed to be interdisciplinary from the beginning. For example, one of my first-year classes was *Modeling and Simulation*, which combined mathematics (calculus and differential equations), programming, system design, and physics. We developed mathematical models that represent behaviors of systems such as planetary orbit, drug concentration in the blood stream, and populations of interdependent species. Another interdisciplinary class I've taken at Olin is *Renewable Energy*, a class for which students received both engineering credit and science credit. In this class, we discussed the fundamental science governing renewable energy forms as well as the current ways of harvesting that energy (engineering). We also considered the social and political considerations involved in energy policy.

I have done both my upper-level design work and independent study in the context of *Affordable Design and Entrepreneurship (ADE)*. Both of these activities involved successful completion of a development-oriented social enterprise or project that required technical innovation and robustness, an economically sustainable business model, and understanding of social and cultural constraints. Not only were the projects interdisciplinary by nature, these activities in themselves necessitated working in interdisciplinary teams composed of engineering students from Olin and business students from Babson College.

In my team, I sometimes encountered differences that arose when the engineering students and business students were working from different unstated frameworks and assumptions. When we seemed to hit a roadblock in communication, I learned to ask people to state their mental model explicitly in order to better understand why they were thinking the way they were. Working closely with business students on an integrated project helped me learn to think from a

business-oriented perspective and undoubtedly will enable me to communicate better with business colleagues in the future.

I have also studied the process of development, be that political, economic, or technological, from an interdisciplinary perspective by taking a Political Science/Economics course on development theory at Wellesley. Understanding the political and economic theories about what makes for sustainable and productive development has given me some context to place my previous experiences into.

In summary, the overarching principles underlying Olin curriculum and culture, amplified by the close collaboration with Babson College and courses at Wellesley College, allowed me to view my current and future work through a multitude of different lenses, a skill which undoubtedly will become useful in my future work.

## Entrepreneurial Experience

Entrepreneurship is integrated in the Olin curriculum. All students take a Fundamentals of Business and Entrepreneurship class – during that class each student starts and runs a business or entrepreneurial initiative during a 2-week challenge. My team designed, produced and sold personalized local postcards and made nearly \$1000 profit during the 2-week period. From this project, I learned that entrepreneurship does not require groundbreaking new technology or completely new concepts, just the application of existing systems (simple printing, postcards, etc.) in the right way to the right audience at the right time.

Olin's design classes also involve a strong focus on user's needs and values, which I believe naturally lends itself to entrepreneurial thinking. For example, during *User-Oriented Collaborative Design*, my team focused on designing for women in the context of self-defense, focusing on figuring out what the right thing was to build, which could be anything: an app, a piece of equipment, a weapon, or a system to promote societal change. We interviewed self-defense instructors and campus police, observed martial arts classes and spoke with dozens of women in public transport stations. From those interactions, we developed several ideas that we were confident could be turned into viable products, because they were based in direct interactions with users and potential customers.

Finally, at Olin I have learned to see entrepreneurship as a way of making innovative technology accessible to its users (in order to avoid building systems that no one can access to use). Therefore, entrepreneurship was a critical component in our *ADE* project – in addition to developing a technologically feasible system, we devised a financing, distribution, sales, marketing, and support system to make our product economically accessible to users. In this context, we used entrepreneurship as a way to distribute technology – that is, we aimed to make our product and sales of the press and graters profitable in order to be scalable and sustainable, rather than profitable for the sake of profit.

All of these experiences allowed for a more holistic understanding of the design process, which I hope to continue using in the future to ensure that the projects I work on are both technically feasible and financially sustainable.

## **Global Learning**

In Fall 2011, I studied abroad in Santiago, Chile at La Pontificia Universidad Católica de Chile (PUC).

I intentionally chose to arrive in Santiago without arranging housing, registering for classes or doing much other particular preparatory work – because I hope to work long-term in international development, I wanted to test my ability to work things out on-the-ground in a new country. I was happy to find I was able to do this, even though cold-calling about rooms listings in my very rusty Spanish was certainly a challenge!

Being an international student (and later spending 7 weeks travelling independently) forced me to grow out of my comfort zone by continually interacting with new people. One thing I found particularly rewarding was practicing a small repertoire of jokes that I could tell in Spanish. I found that a few jokes could usually break the ice in a campground or a long-haul bus, and usually encouraged others to start telling their own favorites.

My ADE work has been centered in Ghana. While I have enjoyed this, when I was in Chile, I fell in love with the idea of returning to Latin America someday. My ability to speak Spanish would allow me to work much more directly with users, and correspondingly to design products that are a better fit with their real needs, while in Ghana many of my interactions with users are constrained to what I can communicate through a translator.

Studying, living, and traveling in Chile gave me confidence that I can handle living and working abroad in my future work, as well as allowed for development of practical skills in language and interpersonal communication. This experience, combined with my work on providing access to clean water in Haiti, allowed for a more holistic awareness of the world around me. Indeed, I have learned a great value in learning about foreign cultures, the role of the U.S. in the world, and my role as a global citizen – to make a difference by helping to develop sustainable technologies to better lives of those who are in need, both here in the U.S. and abroad!

## **Service Learning**

During my time at Olin I have been involved in a number of service learning activities. One of such activities that particularly stands out in my mind is Olin's Habitat for Humanity, a group with which I travelled twice to North Carolina to participate in a spring break house build. Working alongside future home-owners and regular volunteers on these trips have provided an opportunity for me to engage with a community outside of Olin's that I would not otherwise encounter and to recalibrate my perspectives.

An unexpected benefit of construction-based service has been the chance to get some hands-on experience with tools and processes that, as an engineer, I may someday design around. I believe that having some idea of what it takes to actually make a product – be it a key ring or an

entire house – can help an engineer better design products that are easier and faster to produce quality versions of.

During these Habitat build trips, I have also learned that I genuinely enjoy service – spending my spring break on a house build was authentically recreational and enjoyable, and not a grudging “sacrifice.” I would like to continue integrating service into my life, not only for the good outcomes, but also simply because it makes me happy.

I have also been involved in service to the Olin community, especially by serving as a member of Olin’s Honor Board, which is responsible for promoting the Honor Code culture and resolving Honor Code disputes. I have learned that keeping a strong community requires continual input and effort from many members, often behind the scenes – but the rewards of the community are very worthwhile.

## **Summary**

The examples above are just a small part of the environment and activities I have been immersed in for the past four years. These activities made me who I am today, a global citizen, an engineer, and an entrepreneur with a vision of contributing to the process of changing the world to the better.