Student Led Service-Learning Initiative: Installation of Photovoltaic Water-Pump Systems in the Ecuador Amazon Rainforest

Kelly M. Williams  
California Polytechnic State University  
San Luis Obispo, CA

The National Electrical Contractors Association (NECA) student chapter at California Polytechnic State University in San Luis Obispo, California was selected by an association called ELECTRI International to participate in their Student Community Service Initiative program. The goal of the program is to “Encourage construction management and electrical engineering students to take an active role in improving access to electricity in developing communities” (“Student Passport Program”). This paper summarizes the findings of a student-led project made possible by ELECTRI International’s program. The project included coordinating, funding, and executing a project to facilitate the installation of photovoltaic water pump systems to indigenous villages in the Ecuador Amazon Rainforest. A team of five students and two faculty members from California Polytechnic State University’s NECA student chapter travelled to the Ecuador Amazon Rainforest in March 2018 to execute the project. This project had three main goals. First, was to increase student interest in sustainable MEP systems. Second, was to expand student knowledge and experience in running a construction project. The third was to inform construction industry, faculty, and students of the personal and professional benefits of supporting student service learning trips as well as ways to support. In this paper, I will address how all three goals were met, as well as all other discoveries through the execution of this project.

Keywords: Photovoltaic, Sustainability, Student Development, NECA, Service Projects, Ecuador

Introduction

Project Background

The National Electrical Contractor’s Association (NECA) student chapter on campus has a strong past relationship with a non-profit organization called Reach Beyond. A few years ago, Cal Poly received a large donation in the form of solar panels from Sunpower Electric. Cal Poly then donated a number of those panels to Reach Beyond. This is an international organization devoted to assisting people in impoverished countries to improve their quality of life. Specifically in Ecuador, Reach Beyond works with indigenous villages that are off the electrical grid with no access to electricity or running water. Photovoltaic powered water pump systems make it possible for remote villages to have access to fresh water. By leveraging the clubs strong relationship, and the available donated panels, NECA was able to partner up with Reach Beyond. Because they have a base location in Shell, Ecuador and experience installing the systems, we worked with them to determine specific site locations and to coordinate other logistical details. The team’s project scope included, funding, coordinating and executing help with installation of photovoltaic water pump systems to indigenous villages in the Ecuador Amazon Rainforest.

Project Purpose

There were multiple motivators for taking on this project. First, was to support the effort of providing developing communities with access to clean water. In addition, this project was an effort to increase student interest and exposure to MEP systems. As the president of the NECA student chapter at Cal Poly and the Co-Captain of the ASC Cal Poly electrical team, I have developed a strong interest in learning about MEP systems. I believe that it is extremely beneficial to anyone’s career in the construction industry to have a familiarity with this topic. For this reason, I aimed to increase my own exposure as well as other students via NECA club member participation. The next goal was to experience problem solving of various logistical, communication, and financial challenges associated with service learning projects. The final goal of this is to inform construction industry, faculty, and students of the personal and professional benefits of supporting student service learning trips as well as ways to support.
Key Factors

Funding

Funding for this project was two-fold. Starting last May, the team worked to plan and execute a NECA club fundraiser, specifically for the effort of this project. The first step in this was putting together a funding strategy proposal to present to club faculty advisors as well as the construction management department head. This was essential in gaining trust from faculty and showing that initiative and commitment were present. The next step was finding an industry representative to support and provide insight. We were able to find support in a representative from Prime Electric. With his guidance, we came up with the idea of putting on a clay-shooting tournament and raffle at a specific venue in Morgan Hill, CA. The event was industry wide with forty participants represented by seven different companies. The NECA student team was fully responsible for creating the budget, managing financials, booking the venue, obtaining raffle items, and coordinating all other details necessary for the event. The event was successful in raising just under $7,000 for the project. This was an extremely valuable aspect of the service-learning project for students and industry members. Through putting on this event, we as students were able to practice the essential skills in communication and organization that transferred over to the coordination and execution phases of the project. Also, we were able to network with a large number of industry members and make them aware of our project efforts. For industry members this was a unique opportunity to network with students who are future industry members. In addition, this is a great opportunity for industry members to support student efforts to develop students’ skills through a service-learning project, making them more valuable when they enter the industry.

The second source of funding for this project was NECA and their research foundation, ELECTRI International. This organization has implemented a program called the “Student Community Service Initiative” which provides NECA student chapters with the opportunity to compete to receive a $20,000 dollar donation towards their project. With the help of our club advisor, Lonny Simonian, our NECA student chapter submitted a proposal. Upon our submission we were shortlisted and called to have one student present our proposal to the entire organization. My faculty advisor and I flew to Florida and I was honored to present. After I presented, ELECTRI voted to give us the donation. ELECTRI’s Initiative is an important funding process to bring industry awareness to because it is an invaluable way to promote student interest in MEP and other trades. It is specialty trades that generally have less initial student interest within the industry and this program successfully leads talented students to have an interest in pursuing a career in these fields.

Coordination

There is an immense amount of planning and coordination that contributes to an international service-learning project. As the lead of this project, one of the largest responsibilities was maintaining clear and effective communication amongst all parties involved. For one, it was essential that there was clear and effective communication amongst the internal team. It is with this project that I learned that everyone must have distinct roles that they are aware of otherwise time and personnel are wasted. In addition to internal team coordination, it was important to have effective communication with our faculty advisors, Reach Beyond representatives, Cal Poly Club services, construction management department administrators, and Cal Poly International travel. Like in all construction projects, ensuring that all parties are on the same page was crucial to success. In all of this coordination, I reaffirmed my belief in following up with people and making sure everything is in writing. With so many details being talked about at each meeting, phone call, and Skype call, it was easy for people to change what they originally said. Through this I was able to understand the value of meeting minutes first hand as we made sure to keep them from every conversation. This was one of the first times I have ever had to learn how to seriously delegate and track the work of my teammates and parties involved with the project and it was a great lesson in leadership.

Execution

The team of six students and two faculty members travelled to three different villages for help with installation of PV water pump systems. At each village we were able to contribute physical, intellectual, and personable value to the process of install. The first village we visited was called Kawa and it was about two and a half hours away from Reach Beyond headquarters in Shell. At Kawa our Cal Poly team took the opportunity to analyze a nearly completed
install. This system consisted of PVC pipes, four lower level plastic feeding tanks, one photovoltaic panel powering one pump, a 30 feet high steel structure holding up the main water tank, and thirty distribution access points to the majority of the houses in the village. It is at this site we were able to understand the relationship between the villagers and their system and what affects the system has. At the second village, we were able to use our system knowledge obtained from construction management courses, separate research, and form the previous site. Pulling from these sources of information, we were able to provide insight on a broken down system. The team analyzed the tanks capacity and structural integrity, the capacity of the PV panels, and traced the PV panels back to the main panel in order to find missing connections and system components. For example, we were able to map out a location and the necessary materials to install a new pump for future work. Finally, in the third village, we were able to conduct analysis of a site without a system in place and determine the level of qualification for a system the site has.

**Deliverables**

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Title</th>
<th>Description</th>
<th>Date</th>
<th>Location</th>
<th>Exhibit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Proposal to Advisor and Department Head</td>
<td>Met with NECA club advisor and the Construction Management department head to get the “green light” to start obtaining funding and coordinating.</td>
<td>5/24/17</td>
<td>San Luis Obispo, CA</td>
<td>A</td>
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<tr>
<td>2</td>
<td>Construction Management Advisory Council Presentation</td>
<td>One teammate and I were granted the opportunity to present our project at a CMAC meeting to gain industry awareness and support</td>
<td>5/26/17</td>
<td>San Luis Obispo, CA</td>
<td>N/A</td>
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<tr>
<td>3</td>
<td>Funding Part 1: Clay Shoot Tournament</td>
<td>Orchestrated a forty-person, industry wide tournament and raffle. Created the budget, managed financials, booked the venue, obtained raffle items, and coordinated all other details necessary for the event.</td>
<td>9/25/17</td>
<td>Morgan Hill, CA</td>
<td>B</td>
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<tr>
<td>4</td>
<td>Funding Part 2: ELECTRI Council Meeting Presentation</td>
<td>Submitted a presentation and proposal for the ELECTRI Student Community.</td>
<td>1/19/18</td>
<td>Palm Beach, FL</td>
<td>C</td>
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<td>5</td>
<td>Meetings</td>
<td>Weekly internal team meetings and monthly Skype meetings with Reach Beyond.</td>
<td>5/24/17-4/15/18 (Entire Duration)</td>
<td>San Luis Obispo, CA</td>
<td>D</td>
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<td>6</td>
<td>Project Budget</td>
<td>Maintained a travel and material budget throughout the project duration.</td>
<td>5/24/17-4/15/18 (Entire Duration)</td>
<td>San Luis Obispo, CA</td>
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</tr>
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<td>7</td>
<td>Project Schedule</td>
<td>Encompasses every day of travel and execution.</td>
<td>2/1/18</td>
<td>San Luis Obispo, CA</td>
<td>F</td>
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<tr>
<td>8</td>
<td>Execution</td>
<td>Spent three days facilitating installation process.</td>
<td>5/18/18-5/26/18</td>
<td>Ecuador</td>
<td>G</td>
</tr>
<tr>
<td>9</td>
<td>Close Out</td>
<td>Completed reports, thank you letters, and final budget analysis.</td>
<td>3/27/18-4/30/18</td>
<td>San Luis Obispo, CA</td>
<td>N/A</td>
</tr>
</tbody>
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**Lessons Learned**

This project presented various difficulties that provided extensive lessons learned for my team and myself. The lesson we learned was the necessity of contingency. When travelling abroad to execute a project, there are a number of issues that may arise and increase costs. One for example came in the way of health concerns travelling to another country. After budgeting the travel costs per person, we came to realize that there were multiple vaccinations and medications recommended for travel to Ecuador. The costs for these significantly increased the travel cost per person. Another huge lesson we learned was to schedule to account for weather. Especially in Ecuador, rainstorms occur often and are difficult to predict. We came across a storm in the jungle that cancelled the plane we were supposed to take to another village and it reduced our time allotted for working. We learned here that it is important
to have some extra days in a project schedule in order to account for unpredictable delays. Along with that, another unpredictable delay was our travel from Quito, Ecuador to Shell, Ecuador. This is normally about a four hour drive but we had an hour delay for a car accident and then another four hour delay form our car breaking down. We arrived in Shell much later than scheduled and had to pay for extra cab trips we did not anticipate so this clearly reaffirmed the lesson of conservative budgeting in scheduling but it also was an important lesson in adapting. This project helped me learn that in construction projects, it is inevitable that problems will occur and it is essential to learn how to become adaptable. This lesson was reaffirmed over and over again on this trip which also taught me the value of mitigating risk before a project starts as much as possible.

New Knowledge

This project provides new insight on the benefits to construction management faculty, industry, and students getting involved with student service-learning trips. Additionally it provides knowledge as to how each group can be involved and support.

For construction management faculty members, supporting service-learning projects are an excellent way to engage with students and provide them with a once and a lifetime opportunity. In our team, we were fortunate to have two very inspiring faculty members, Lonny Simonian and Paul Redden. These faculty members were so dedicated to providing us with learning experiences every step of the way and I will be grateful for the rest of my life. Benefit teachers stand to gain from getting involved with service learning trips is that they will be able to effect the development of students in an exponentially more impactful way than they could in a classroom. Additionally, specific to this project was the benefit getting to expose us students to their specific areas of expertise and increasing our interest in getting involved with those fields. As far as getting involved as a teacher, this can be done by networking and maintaining strong relationships with organizations that can provide funding as well as organizations that are involved with projects.

To industry members, student lead construction service learning projects are a great opportunity to develop the skills of the future generation of the construction industry. Additionally, getting involved with these projects is an effective way to solidify strong relationships with students and resultantly recruit future employees. Of course by supporting the effort industry members will connect with the students involved and create a bond, but additionally, this builds in to a lot more. When students are impressed and enjoy working with industry members who involve themselves in their service learning project efforts, they then relay the message to their friends. As a result a large pool of prospective students get a great impression of the companies involved. Specifically with our project, their were a number of industry members who reached out, including Jeff Messana, a representative from Prime electric. Jeff was involved with supporting us from the beginning stages of fundraising and was there to help all the way through. This effort made a lasting impression on all of us students and we will always have a great respect for him and his company.

To construction management students, service-learning projects are an incredible way to excel personal and professional development. From my personal experience, I learned how to communicate with industry members about complex matters in direct yet appropriate ways. From this project I have gained a huge amount of confidence in collaborating with others professionally. Also for construction management students, these projects are beneficial in learning about team dynamics and leadership. Because this project had so many intricate details and moving parts, delegation, accountability, attitude, and communication within the team were heavily tested. Being placed in a situation with time sensitive, high-pressure tasks to accomplish gives students a great lesson navigating all of these, which applies great to real world situations we will come across once we enter the industry. Another benefit to this project for students is they are exposed to MEP construction. Personally, this trip confirmed my personal interest in electrical construction and will be applying to electrical contractors companies, as I get ready to graduate. Additionally, being able to take a full team of five students and have everyone come home and talk of their experiences, countless students gained exposure and interest in MEP construction. Finally, this project benefits students as it shows the value of dedicating our time to helping others. Travelling to this developing country and seeing how simply people in indigenous villages live provided us all with new perspective, a greater understanding of the world, and new appreciation for the lives we live.
References