Logistics of Construction in Agbokpa, Ghana

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In August of 2019, three Cal Poly CM students will travel to the remote fishing village of Agbokpa in Ghana. Our project is to install a water filtration system that will create potable water for the villagers that currently have to walk miles to obtain clean water. We will be laying nearly 1000 ft of pipe, installing a solar powered pump, and building a water filtration system hours away from any electricity. A project of this type requires a great deal of logistical planning in order to ensure that all aspects of the project is thought of and planned for. My project focuses specifically on the logistics of construction in a foreign country such as Ghana. Along with a site map of the construction site, I have created a logistics plan that covers logistical issues such as what to do with materials, where and how we will procure extra labor if necessary, catering and food, etc. With this logistics plan, I will ensure that everything is accounted for and prepare our team for a successful project.

Key Words: Logistics, Ghana, Water Filtration, Solar

Introduction

I have always had a mindset that one should always help the less fortunate if they are ever in a position to do so. This project has allowed me the opportunity to make a difference in another part of the world that I would not have had otherwise. The overall project involves two Cal Poly clubs, NECA and MCAA, where together we will complete the construction of a solar powered community center in a remote fishing village that will house multiple refrigeration units, so that the locals can store their food for longer periods of time, and a water filtration system, so the locals can obtain filtered drinking water without walking miles to the nearest supply.

I am a part of a group of three Cal Poly MCAA students that are responsible for the pumping and filtration portion of the project. The project this paper will be focusing on exclusively will include the logistics of installing a pump located in a lake approximately 1000 feet from the village center, building a water filtration system that will feed into NECA’s refrigeration units, as well as making the filtered water available for the village’s consumption.

Figure 1: Sketch of MCAA Pump and Filtration System

This project is designed to aid the residents of the remote fishing village that we will working in, Agbokpa. We are asking for nothing in return for building this system because they are allowing us to come into their village to practice our skills and gain hands-on knowledge as we build them a water filtration system. This water filtration
The project was first introduced by a physics professor whose wife is the Chief of Agbokpa’s daughter. NECA was first brought on to ensure that they could get electricity for a pump and refrigeration system, then MCAA was brought into the project to take over the responsibility of installing the pump, pipe, and filtration system necessary for the refrigeration system to run most effectively.

**Procurement Process and Research Findings**

The main issue that was associated with the logistics of the project was procurement of materials and labor. It was clear that because we were running on such a short schedule of 20 days that we were going to need to hire labor forces in order to complete the entirety of our scope of work. We decided to focus our attention on hiring nonskilled labor so that we could maximize the amount that our team was focusing on the skilled parts of the job while in country. Hiring nonskilled labor had two main benefits: 1) it would be less expensive than hiring skilled in the city of Accra, and 2) we could utilize locals that lived in Agbokpa and contribute to the local economy.

When procuring materials, I broke it up into two categories. The first category was raw materials that we would use for the project, such as pipe hose, pvc, fittings, water storage tanks, etc. Our team decided that buying the material in country would make the most sense because of two main reasons: 1) the import duties would almost add $5,000 if we were to ship $10,000 worth of materials, and 2) the materials we bought in the United States would not match the metric system materials we bought in Ghana if we had to buy extra parts. The second category of material procurement was tools needed to complete the project, such as reciprocating saws, skill saws, pipe cutters, etc. We focused our efforts on obtaining these materials through donations; we saved more money getting the tools donated and paying the import duties than buying all of the tools in country.

The last major procurement items were the means of travel to Ghana. MCAA had to coordinate with NECA to ensure that we were all in Accra, the capital of Ghana, at appropriate times to make sure we were not bussing in and out of the Accra, requiring Professor Heston or other laborers to leave every day. MCAA decided to arrive in country a few days early in order to ensure we could procure all of our material and be on site by the same time NECA arrives.

**Ashesi University Student Support**

Our project team was able to utilize a local university in Ghana to aid us in the budgeting and procurement process of materials, Ashesi University. Ashesi University was able to provide us with prices that we were able to use while we were estimating the project, which helped our team get our budget as close to the actual cost we will incur while in Accra and Agbokpa. The students of Ashesi University also will help our team secure the local prices while we are in Ghana, not just the posted prices that are designed to charge non-locals extra cost. In addition to procurement support, Ashesi University has also offered construction support. The university students have helped our project team by explaining how locals carry out construction in Ghana and typical practices throughout the area. The university students have proved an exceptional resource throughout the entirety of this project and will surely prove helpful during actual construction.

**Deliverables**

This Agbokpa, Ghana project was an excellent project because it exposed me to many different preconstruction activities and processes that need to occur before a project can begin and be successful. Although I am going to Ghana to work hands on and build the system, these activities and processes I had to deliver were invaluable and I was able to take a lot away from each. The deliverables that I had to complete in order to ensure the success of our project were as follows:
• Logistics Plan for Construction in a Foreign Country, which included:
  o Materials
  o Material Storage
  o Waste
  o Labor
  o Schedule of Manpower
  o Housing and Sleep Accommodations
  o Catering and Food
• Construction Site Plan

Lessons Learned

Through the preconstruction process, I learned that in order for a project to be successful it has to be thought of meticulously. I was constantly working with all of the team members to ensure I was gathering correct data and creating the proper documents. I was able to apply knowledge I gained in class about due diligence and site preparation and apply it to a completely new and challenging area of the world. I believe I gained a lot of communication skills as well, not only talking with team members but also talking to fellow tradesmen. This project features two teams working on different scopes but all for the same project, therefore, there was a great amount of coordination that took place to ensure all team members were aware of what was expected from each other.

This project was by far the greatest learning experience I have had in all my years at school. This project put me into a real life scenario where I was having to coordinate with team members and fellow tradesmen, perform due diligence on a job in somewhere I have never lived before, and basically map out how we were effectively going to complete the project. All of these activities and skills are necessary for a Project Manager to run an effective and successful project, and I will further build upon these skills that I was able to establish once I start my career.

Reflections

Many things went well throughout this project. First and foremost, communication was key and all of the team members communicated well with each other which helped the project run smoothly. I believe what aided this was the fact the entire project team was meeting every week up until project commencement with action items and milestones that needed to be completed for a successful project. In addition, I think the scopes within our team were divided very fairly and evenly. It made the project feel possible within the time frame we were required to gather information and execute. I strongly believe that the project will be completed on time in the entirety of its scope because of how much time we have planned and prepared for construction to begin.

There were not many things I thought the project could have improved on besides the timing of project. I believe that because of the size of our scope on the project, our team should have been brought on earlier into the project’s development. As with any construction project, the earlier a team is brought onto a project the smoother the project will run because there is more time for coordination and information gathering.

This project was great for me personally because I have never been out of the country before and it provided me an opportunity to sharpen my construction skills while experiencing an entirely new culture. I believe I will learn a great deal of hands on mechanical skills that I have not gained in class or on internships. In addition to the technical knowledge learned on the project, I will be set out of my comfort zone and relied upon for the success of a project. I had to perform under pressure on a short schedule, which is one of the most real life scenarios I have ever experienced in all my years at school.
Appendix – Logistics Plan

Construction and Logistics Plan

For
Community Center Water Filtration System
Agbokpa, Ghana
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      3. Delivery

III. Material Storage

IV. Waste

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   B. Procurement

VI. Schedule of Manpower
   A. Arrival of Teams
   B. Critical Activities

VII. Housing/Sleep Accommodations

VIII. Catering and Food
General Scope

MCAA is sending 3 students to a remote village in Ghana, Agbokpa, to build a water filtration system that will tie into NECA’s refrigeration system and provide filtered drinking water to villagers. Our team will be responsible for installing a solar powered pump in the middle of the lake, running all of the hose from the middle of the lake to the community center, installing holding tanks for the water captured, and installing Slow Sand Filters (SSFs) to filter and convert the lake water to potable water. Our team will also be responsible for creating stub-outs for a future irrigation project.

Materials

A. Raw Materials

1. Supply
   Materials, outside of items that are donated or special ordered, will be supplied by local vendors in Accra, Ghana. All pipe, holding tanks, fittings, glue, and hose will be sourced in Accra. All material in Ghana is metric, therefore, using local vendors to supply all of the necessary material will be the simplest way to prevent any metric conversion issues.

   The only items being donated or special ordered include the pump, marine grade wire, special stainless steel fittings directly in contact with pump, and specialty valves. The pump is to be supplied by Sun Pumps. All other specialty items are not restricted to where it is to be purchased or donated from. We are reaching out to many different mechanical contractors and suppliers to receive donations, otherwise, the items will be supplied by the lowest cost vendor.

2. Procurement
   All materials are to be procured by MCAA team members and reimbursed by the MCAA chapter at Cal Poly. All materials are to have valid receipts with imprinted company headings. Materials are going to be procured in country, as opposed to in the United States, to avoid paying extra cost in import duties. Procurement of materials in country will have to be done with cash as most vendors will not accept credit cards due to fraud, thus, our team must be
sure to obtain valid receipts for all transactions they wish to be reimbursed for.

3. Delivery
All Materials, besides the specialty equipment donated/purchased in the United States, will be delivered via a delivery service Professor Heston is in contact with in Accra. Delivery trucks will be hired in Accra and paid upon successful delivery of material to the project site. Some lighter material will be delivered via boat across Lake Volta to save distance traveled and lower the cost of delivery.

Specialty items, such that we cannot supply in Ghana, purchased or donated to the project in the United States will be brought to Accra via checked luggage by one of the MCAA team members. The MCAA team will declare the items upon entering Ghana and will pay the necessary import duties as the customs agents deem necessary. The other specialty items, such as the pump and marine grade wire, were shipped inside NECA’s shipment and should arrive in Accra August 5th through August 7th.

### Critical Material Logistics

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<tr>
<th>Item</th>
<th>Sourcing</th>
<th>Means of Delivering to Country</th>
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<tr>
<td>5000L Water Storage Tank(s)</td>
<td>Duraplast</td>
<td>In country</td>
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<tr>
<td>Submersible, Solar Powered Pump</td>
<td>Sun Pumps</td>
<td>Carry on item (Heston)</td>
</tr>
<tr>
<td>Main Hosing</td>
<td>Duraplast</td>
<td>In country</td>
</tr>
<tr>
<td>Piping</td>
<td>Duraplast</td>
<td>In country</td>
</tr>
<tr>
<td>Marine Grade Wire</td>
<td>Sun Pumps</td>
<td>Via cargo shipping</td>
</tr>
<tr>
<td>50 gal drums (SSF)</td>
<td>Duraplast</td>
<td>In Country</td>
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<tr>
<td>Gravel</td>
<td>Vendor in Accra</td>
<td>In country</td>
</tr>
<tr>
<td>Pressure relief valve</td>
<td>Southland</td>
<td>Carry on item (Podosek)</td>
</tr>
<tr>
<td>Stainless Steel Pump to Hose</td>
<td>Southland</td>
<td>Carry on item (Podosek)</td>
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<tr>
<td>fittings</td>
<td></td>
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<tr>
<td>All tools</td>
<td>Milwaukee (donation)</td>
<td>Carry on item (Nolan)</td>
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</table>
B. Tools

1. Supply
   The supply of quality tools in Agbokpa will be limited in comparison to the supply in the United States, and the quality tools that are available will only be available at a higher price. Therefore, it is best to use the supply of tools available in the United States and ship them to Agbokpa.

2. Procurement
   It is best to try to save funds by procuring our tools via donations. We will reach out to multiple major tool companies and request donations of necessary tools to complete our scope, such as: skill saw, sawzaw, drills, pipe cutters, etc.

3. Delivery
   Due to the fact that the NECA chapter is shipping materials and we can save money by receiving donations for tools, it is worth the cost of import duties to ship our necessary tools overseas. Our tools should arrive before we arrive in Accra, bar delays, so that we will be ready to go to work as soon as we arrive. Any other tools that we do not ship will be checked on the plane by 1 or 2 members and declared at customs as we arrive in Accra.

Material Storage

All mechanical material will be stored in the community center that will be built by the time our team arrives. All of our smaller material, such as fittings, glue, valves, etc. will be stored in the NECA crates that are lockable and being shipped to the site.

Waste

It is important to make the distinction between what excess material will be considered waste versus what excess material will be considered surplus. Excess material in the form of cut-off end pieces or scraps that are no longer usable due to use, defect, or misuse will be considered waste. Our team will utilize a chicken wire/cage system as a form of waste collection for the duration of the project. In addition, to control waste on the jobsite further our team will make routine job walks at the end of each work day in
which we will pick up all waste and bring it to the waste collection system. At the end of the project, it will be necessary to hire a driver to take the waste to the capital in order to dispose of it properly.

Other items that are not used due to a surplus of material, such as extra piping, fittings, or valves will have 2 options depending on the cost of the material. If it is deemed that the item(s) could be used by MCAA on another project in a different location, a team member will bring the item(s) back to Cal Poly given that it can fit in a checked bag that will go on an airplane. Any other items that are project specific, such as leftover pipe, will be left at the jobsite for the village to use in future projects (i.e. irrigation) pending approval from the Chief.

Labor

A. Supply

There will be 2 types of labor that we will need in order to ensure a successful project: 1) unskilled labor, and 2) skilled labor.

Unskilled labor will be supplied mainly by the local villagers of Agbokpa. This has 3 main benefits: 1) we will be able to procure labor for much cheaper, 2) we will be contributing to the local village economy via purchasing local labor instead of labor from a nearby village, and 3) we will be able to have certain parts of construction complete by the time we arrive. The main reason for use of unskilled labor is to allow us to begin work on our mechanical system as soon as we arrive, therefore, the main activity we will utilize the unskilled labor for is the trenching required from the community center to junction box at the head of the lake.

Skilled labor will be supplied by workers from Accra, the capital of Ghana. If skilled labor is required to do such things as welding, we will have to hire workers from Accra. This labor will be considerably more expensive and, therefore, undesirable to use. This type of labor is only going to be utilized if we believe there is a need to compress the schedule and items, such as the water tower, are required to be built before we arrive.
B. Procurement

Labor, regardless of skill level or location, will be procured locally in Ghanaian currency. This requires we withdraw cash from ATMs in Ghana to convert to Ghanaian cedis. Withdrawing from ATMs will ensure that we utilize the best exchange rate possible and ensure that we are only taking out the exact amount of money needed so that we don’t have to convert back to USD and lose money.

Schedule of Manpower

A. Arrival of Teams

Our teams are scheduled to arrive in as little separate groups as possible so that there would be as little bussing payments as possible. We were able to separate the entire project team into 2 separate groups, an MCAA group and a NECA group. MCAA will arrive on August 7th in order to source and procure material; we will also aid in unloading the shipping container that NECA sent to Accra. NECA will then arrive on August 12th which will give MCAA enough time to source, procure, and transport their material from Accra to Agbokpa before they need to leave the village again.

Once teams reach Accra, Professor Heston will be hiring a driver to transport the students to a checkpoint on the opposite side of the lake. The teams will then take a boat transport to reach the village of Agbokpa.

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<th>Full Name</th>
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<td>Lenny Simonian</td>
<td><a href="mailto:lsimonian@calpoly.edu">lsimonian@calpoly.edu</a></td>
<td>Accra, GH</td>
<td>Y</td>
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<td>Will Myers</td>
<td><a href="mailto:wmyers@calpoly.edu">wmyers@calpoly.edu</a></td>
<td>SFO</td>
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<td>Y</td>
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<tr>
<td>Casey Smith</td>
<td><a href="mailto:cssmith174@calpoly.edu">cssmith174@calpoly.edu</a></td>
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<td>Michael Klee</td>
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<td>Eugene Long</td>
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<td>Fletcher Podosek</td>
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Housing and Sleeping Accommodations

When the Mechanical team arrives on the 7th of August, we will be sourcing and procuring most of our material in Accra for the first few days. Therefore, to accommodate our stay in Accra we will be staying at the university dorms located at Ashesi University. However, if these sleeping arrangements fall through, each student will need to purchase hotel rooms within Accra. The mechanical team will be accompanied by Professor Heston while in Accra sourcing material (making a total of 4 individuals), so two (2) hotel rooms with two (2) beds each should be satisfactory for the stay. Our duration of stay in Accra will be anywhere from two (2) to four (4) days.

Once the team reaches Agbokpa, it will be remote from hotels and modern technology. All of our team members will need accommodations for sleep for the duration of the project which is ten (10) to sixteen (16) days. Professor Heston's contact within the village (the Village Chief) has offered to let all of the teams' members sleep in his house. There are two (2) separate rooms which will be divided based on gender. All team members will rent mattresses from the locals that are 3' thick foam pads. Team members will be responsible for bringing personal sheets or sleeping bags to cover the mattress, while another sheet is recommended to protect against mosquitoes during the night. Mosquito nets are recommended and will be available for purchase while we are procuring material in Accra. All other sleeping amenities will be dependent on what he/she wants to bring with them in their bag.

Our project team believes sleeping in the Chief's house is much more secure when compared to sleeping in tents. This is not only in regards to animals and insects but theft as well.

Catering and Food

MCAA will pay a personal chef to cook breakfast, lunch, and dinner for each team member everyday. This will cost around $8 a day per person for both the service and food itself. Hiring a chef is necessary to ensure all the food consumed on the trip is as sanitary as possible and cooked thoroughly.