Community Development in Santa Ana

Akansha Arun Deshpande  
*Worcester Polytechnic Institute*

Alejo Guillermo De Carolis  
*Worcester Polytechnic Institute*

Franco Zuccolillo Mateo  
*Worcester Polytechnic Institute*

Isabelle Luisa Jaquith  
*Worcester Polytechnic Institute*

Follow this and additional works at: [https://digitalcommons.wpi.edu/iqp-all](https://digitalcommons.wpi.edu/iqp-all)

**Repository Citation**

This Unrestricted is brought to you for free and open access by the Interactive Qualifying Projects at Digital WPI. It has been accepted for inclusion in Interactive Qualifying Projects (All Years) by an authorized administrator of Digital WPI. For more information, please contact digitalwpi@wpi.edu.
Community Development in Santa Ana

An Individually-Sponsored Residential Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the requirements for the
degree of Bachelor of Science

By
Alejo De Carolis
Akansha Deshpande
Isabelle Jaquith
Franco Zuccolillo

Date:
27 June 2019

Report Submitted to:

Shirley Alaya
TECHO Paraguay

Professor Robert Traver
Worcester Polytechnic Institute
# Table of Contents:

**Table of Figures**

| Table of Figures | 2 |

**Chapter 1: Introduction**

| Chapter 1: Introduction | 3 |

**Chapter 2: Background**

<table>
<thead>
<tr>
<th>Chapter 2: Background</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Paraguay</td>
<td>6</td>
</tr>
<tr>
<td>2.1.1 Limpio</td>
<td>6</td>
</tr>
<tr>
<td>2.1.2 Santa Ana</td>
<td>7</td>
</tr>
<tr>
<td>2.2 Community Development in South American Countries</td>
<td>8</td>
</tr>
</tbody>
</table>

| 2.2.1 TECHO Paraguay  | 10 |
| 2.2.2 A Todo Pulmon   | 11 |

**Chapter 3: Methodology**

<table>
<thead>
<tr>
<th>Chapter 3: Methodology</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Introduction</td>
<td>12</td>
</tr>
<tr>
<td>3.2 Workshops</td>
<td>12</td>
</tr>
<tr>
<td>3.3 Bridge Construction</td>
<td>13</td>
</tr>
<tr>
<td>3.3.1 The Analytic Hierarchy Process (AHP) Method</td>
<td>14</td>
</tr>
<tr>
<td>3.4 Design Alternatives</td>
<td>14</td>
</tr>
<tr>
<td>3.4.1 Advantages and Disadvantages of Design Alternatives</td>
<td>15</td>
</tr>
<tr>
<td>3.4.2 Professional Recommendations</td>
<td>15</td>
</tr>
<tr>
<td>3.4.3 Implementing the AHP Method</td>
<td>16</td>
</tr>
<tr>
<td>3.5.1 Plaza Improvements</td>
<td>19</td>
</tr>
<tr>
<td>3.5.2 Distribution of Trees</td>
<td>20</td>
</tr>
<tr>
<td>3.6 Survey Questionnaire</td>
<td>20</td>
</tr>
</tbody>
</table>

**Chapter 4: Results and Discussion**

<table>
<thead>
<tr>
<th>Chapter 4: Results and Discussion</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Bridge Construction</td>
<td>21</td>
</tr>
<tr>
<td>4.2 Developmental Workshop</td>
<td>24</td>
</tr>
<tr>
<td>4.3 Plaza Enhancement</td>
<td>24</td>
</tr>
<tr>
<td>4.4 Survey Questionnaire</td>
<td>25</td>
</tr>
</tbody>
</table>

**Chapter 5: Recommendations for Future Projects**

| Chapter 5: Recommendations for Future Projects | 29 |

**Bibliography**

| Bibliography | 30 |

**Appendices**

<table>
<thead>
<tr>
<th>Appendices</th>
<th>32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A</td>
<td>32</td>
</tr>
</tbody>
</table>
Appendix B 35
Appendix C 36
Appendix D 37
Appendix E 38
Appendix F 39
**Table of Figures**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AHP relationship diagram</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>Pairwise comparison matrix of criteria</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>Weight Scale</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Pairwise comparison between design alternatives in regard to the “Labor” criterion</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>Bridge-Related Costs and Amount Fundraised</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>Completed Bridge in Santa Ana</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>Census of Community Member Involvement</td>
<td>28</td>
</tr>
</tbody>
</table>
Chapter 1: Introduction

Paraguay is a South American country home to various working-class communities that are underdeveloped, understaffed, and underfinanced. The working-class population as a whole is in need of places to live and interact that are both functional and safe. In May, our ISRP team arrived in Limpio, Paraguay, to assist the community of Santa Ana. Santa Ana is one of many communities that TECHO, a non-profit organization, identified as one in need of fundamental improvements. Before our arrival, a bridge stood at the entrance to the community that was not readily accessible for travel by foot or car. The community members also lacked a framework for problem solving. Our project originally aimed to achieve two deliverables: bridge reconstruction, and a series of five developmental workshops. However, upon arrival to the community, it was clear that the community members were motivated and ready to start with more than one hands-on project. A meeting with TECHO also revealed that the structure they use for problem identification and planning was very similar to the one we intended to use, and they were able to complete it in one day. Due to TECHO’s advice and the community’s eagerness, we decided to combine the five different workshops into one single workshop. This allowed us to add to our deliverables and make more of an impact. Therefore, our final project achieved four deliverables. The first was a developmental workshop with community members that will include educational tools that all members can use in the future. The second deliverable was the reconstruction of a dysfunctional bridge that is causing accessibility problems within the community. The third deliverable was the enhancement of the current plaza area and the
addition of green spaces. The fourth and final deliverable was the execution of a survey questionnaire in the community to help us evaluate how our project was received.

The first deliverable was the implementation of a developmental workshop during which our team members shared various strategies with community members. The goal was for them to be able to identify problems and execute solutions in difficult situations. The workshop covered problem identification, prioritization of problems, analysis (problem, cause, and effect), possible solutions, and acknowledgement of future projects. Upon our arrival, we introduced ourselves and assured community members collaboration was imperative to achieve our final goal. The workshop began with an overview of its purpose and proceeded with interactive discussion and hands-on activities. A template was provided to each community member at the start of the workshop, and they filled it out as the workshop went on. Although our original plan was to conduct the workshop first, time constraints and impending weather led us to reschedule the workshop until after bridge construction.

The second deliverable was the reconstruction of the dysfunctional bridge that stood at the entrance to Santa Ana before our arrival. Upon arrival, we ordered the necessary materials to reconstruct the bridge following building codes and enlisted the help of community members to rebuild a functioning bridge. With these materials, we started by taking down the old bridge and replacing it, step by step, with a new one. We used tubing that sustains significant weight and water volume. All of the materials and building methods used were decided on by a design matrix constructed during the research period of our project. Collaborating to complete a task like bridge re-building provided the community members with a real-life problem-solving
example, even before the workshop had begun. Upon completion of the bridge, community members were able to pass through the community on foot and in vehicles safely, and there was little to no erosion in the soil.

The third deliverable was the addition of green spaces and enhancement of the plaza. Approaching another non-profit organization, A Todo Pulmon, they agreed to provide Santa Ana with 150 trees and some citric plants. Thankful for their contribution, there is strong hope that the plants and trees would not only provide sustenance and shade, but also a sense of responsibility. By planting some of the plants in shared areas, and distributing the rest evenly among families, every household would be responsible for the growth and maintenance of their own share. The developmental workshop revealed that one of the community member’s priorities was a common recreational space where they could get exercise, hold meetings, and spend time together. Although it is impossible to build on the land since it is government-owned, through collaborate work the plaza was enhanced with various plants and a volleyball court. This deliverable was unique in that it was driven by the community members incentive. After seeing the bridge construction come to life, Santa Ana people were inspired to use the tools that they learned in the workshop to begin the plaza development process on their own.

The fourth deliverable was a series of interviews conducted in the community, during which community members answered questions designated by the survey questionnaire. The goal of the interviews was to receive feedback on how the project received, what was done well, what could have been done better, and what Santa Ana would like to see done in the future. In
addition, the survey allowed to be able to keep track of what activities which families were involved in, in order to gage how invested the community members were in the project.
Chapter 2: Background

2.1 Paraguay

Landlocked between Argentina, Brazil and Bolivia, Paraguay is now a calm nation enjoying economic growth sustained over the last decade. The tranquility Paraguay enjoys nowadays certainly serves as a strong contrast to the country’s turbulent history. From the colonial colonization, which many have called a genocide, to having been involved in two of the biggest wars the continent has seen, up through the longest dictatorship of modern history, Paraguay has faced much hardship and it is reflected in its culture, economic development, but more importantly in its society.

Among the most homogenous populations in America, Paraguayans are a blend of Europeans and Guaranis, the land’s ancestors. Deeply rooted into Paraguayan culture, Guarani ties are why Paraguayans are so nationalistic.

Like many countries in South America, plus a critical historical factor, Paraguay is greatly affected by poverty. Although improvements have been down to reduce poverty, it is still an alarming challenge. This project aims to make a difference in that respect.

2.1.1 Limpio

Limpio is located in the Central Department, Paraguay. The city, located 23 kilometers outside of Asuncion, has an approximate area of 118 square kilometers shared in 9 companies and 48 settlements that are the home to 4,342 families. The Limpio community was formed due to the migration of many families away from the city due to economic hardship. The majority of community land is in the hands of the government with a mere 31.3% being under private
ownership. An explosive growth rate and high population density, in addition to a lack of infrastructure, has made it challenging for its inhabitants to develop opportunities. Limpio inhabitants have reported that their three main problems are Health (19.5%), disunity between neighbors (19.5%), and a lack of electricity (14.6%). The people are self-sufficient as most of the settlements do not have a housing program that is facilitated by the State or any other organized group and over two thirds of the community does not rely on any assistance from groups like the government or civil society organizations. Based on a survey conducted by TECHO, an overwhelming 73.3% of the settlements in Limpio depend on plans for development approved by the local council while they also have plans from the Social Action Secretary. The communities are on a path of development. For example, 71.1% of homes are connected to the sanitary waste elimination system and 63% have access to potable water. However, they do have a long way to go, only 44.4% of homes have electricity, 40% of streets are named, and 48.9% of settlements have public lighting. (TECHO Paraguay, 2017).

2.1.2 Santa Ana

Located in the area better known as Rincon del Peñon within the city of Limpio is the small settlement of Santa Ana. With a size of approximately 2 hectares (0.022 square kilometers), Santa Ana is home to 53 families of around 5 to 8 members per family (A, Cardozo, TECHO Intern, personal communication, April 16, 2019). Around 80% of these 53 families are constituted families (consisting of a mother, a father, and their respective children), while 20% are single-parent families, mainly composed of single mothers with their children. Santa Ana, similar to the vast majority of settlements around Asuncion, began as an informal settlement. A
group of families settled in unprotected privately-owned lands. After years of conflict with the landowners, the INDERT (The National Institute for the Development of Land in Paraguay) is attempting to buy the land and formalize the settlement of Santa Ana.

Although Santa Ana is located less than 20 kilometers away from the country’s capital, its inhabitants lack several basic services such as water, sanitation, and waste removal. The settlement has unstable and unregulated electrical installation as a considerable number of homes are manually connected to the electric grid following no safety regulations. This is extremely unsafe for Santa Ana’s community members, especially considering these connections rarely withstand strong winds and storms. Furthermore, the roadwork in and around the community consists mostly of precarious dirt roads. The condition of the roads, particularly during flooding and after rainstorms, impedes the access to Santa Ana and its neighboring communities (D, Samaniego, Vice President of Santa Ana Settlement, personal communication, March 19, 2019).

In terms of the project in Santa Ana, the team will be focusing on the latter problem. Currently, a small, poorly built bridge is the main cause of flooding in Santa Ana during high-raining seasons due to its very limited flow capacity. To prevent this, the team will be designing and building a bridge that accommodates the required flow capacity to reduce the risk of flooding and grant the Santa Ana inhabitants with reliable access.

2.2 Community Development in South American Countries

Latin American countries have been suffering from various social problems for a long time, one of which is poverty in underdeveloped communities like Santa Ana. There is widespread poverty in the region. In addition to poverty, income distribution is seriously
unequal. Wealth concentration is very serious in almost all Latin American countries, but especially in Paraguay. In most Latin American countries, the richest percentage of civilians control 40-70% of the total wealth, while the poorest twenty percent controls only 2-4% of total wealth.

In addition, public safety is rapidly worsening. With the exception of only a few countries like Chile and Costa Rica, murder rates in Latin America have increased at an alarming rate. Murder rates seem to have arisen from various social problems, which have led to the region’s lack of socioeconomic development. “Lack of public safety has worsened the investment environment and foreign investors have become hesitant to make investments there (Shixue).” Poverty and inadequate income distribution have led people to have a negative attitude towards the government. The flourishing social movement has jeopardized the region’s political stability, ultimately leading to bad conditions for the poorest communities.

More efforts need to be made to improve the well-being of working-class civilians, who are often overlooked despite their prevalence in Latin American countries. The objective of economic development is to reduce poverty and raise the living standards of the vulnerable masses. In the same breath, social cohesion can help ease the serious social problems in Latin America. In order to consolidate the steps toward integration between social groups, various policies have been suggested. They include generating more employment, promoting education, and enforcing social protection. Employment is viewed as the most important link between economic development and social progress because it is the main source of household income. Education is essential to the reduction of poverty, since it prepares people to exercise citizenship, and protects the most socially vulnerable groups (Shixue). Social protection gives citizens the access they need to service that reduce their exposure and improve their quality of life. It can
also reduce the risk of unemployment or complete loss of income in old age. Thankfully, there
are non-profit organizations whose goals aim to help solve the problem of poverty and
underdevelopment in communities like Santa Ana and throughout South America. To ensure
work of non-profit organizations working to reduce poverty have the desired impact, it is crucial
that processes are documented along the way. However, often in Paraguay and common among
other Latin American countries, the required supervision is lacking, making it impossible to hold
non-profit organizations and their work accountable as well as to assess their actual impact. The
survey we conducted will attempt to counteract this by directly asking for the impacted
community’s thoughts.

2.2.1 TECHO Paraguay

One of these organizations is TECHO Paraguay. TECHO seeks to eliminate poverty in
19 South American countries through settlement inhabitants and volunteers. Their goal is to link
volunteers and community members to improve living conditions and quality of life for each
community. After evaluation of zones and dialogue with inhabitants, TECHO decides which
settlements will work. After communities have been identified and chosen, TECHO volunteers
and inhabitants make decisions about the interests and needs of the neighborhood. They then
work together to create an action plan to improve housing and habitat problems, keeping in mind
their own capacity. Initiatives promote positive relationships between settlers, who link with
volunteers and carry out the plan. The housing, paved streets, programs and projects that the
community and volunteers proposed then become a reality.

TECHO Paraguay was identified as an organization of interest because of their unique
approach to outreach. Their willingness and devotion to work alongside community members is
rare in non-profit organizations. As per WPI guidelines, an IQP (Interactive Qualifying Project)
should aim to fully or partially solve a problem that the community working with the IQP team has identified. It is then the job of the students to work with an organization or sponsor to develop a plan or solution. The IQP was created to help students learn to solve real-world problems and make decisions with an appreciation for the social and humanistic contexts of their work. Students apply and connect their knowledge to real world problems across the globe. TECHO Paraguay stood out as an organization that would facilitate interaction within the community in order to identify the problems, create a plan, and carry it out.

Upon initial communication with TECHO, they identified several communities in need of help. Attached to each community were the struggles that they were experiencing. Their struggles included things like irrigation or lack of recreational space, with solutions they had either proposed or tried and failed. This was an integral part of the project, as it provided information that could be evaluated from Worcester. After identifying communities whose problems were both feasible to solve, the community in Limpio was chosen, and we contacted community leaders to serve as a springboard into the beginning stages of the project.

**2.2.2 A Todo Pulmon**

Another one of these organizations is A Todo Pulmon. A Todo Pulmon, a Paraguayan NGO, reached out to us upon the start of our work in Santa Ana to donate 150 trees. The NGO aims to develop and implement environmental campaigns that promote sustainable habits in hopes of positively impacting climate change. (A Todo Pulmon, n.d.)

The community members highlighted betterment of their plaza and the addition of green spaces as changes they wanted to be made in Santa Ana. Therefore, the possible relationship with the organization would be a great asset for the community and our team.
Chapter 3: Methodology

3.1.1 Introduction

The project had four deliverables: a developmental workshop, bridge construction, plaza enhancement, and a survey questionnaire. The workshop illustrated sustainable development to community members. The bridge provided an example of problem solving, and an adequate entrance to the community.

3.2.1 Workshops

Before leaving for Paraguay, we planned five workshops covering community development to conduct in the Santa Ana. Each workshop represented a step in the problem-solving strategy we used in the bridge aspect of our project.

However, upon initial meetings with TECHO after our arrival it was determined that conducting one workshop would be sufficient. It would serve the same purpose and summarize the original five into one effective workshop. This decision was made because one workshop would be more conducive to the low level of education in the community. It would also allow better maintenance of the relationship between the community members and us. In the past, TECHO has used a template called the “Diagnóstico Participativo Comunitario”, which closely resembled our original plan, and had great success. The template, shown in Appendix D, includes sections for problem identification, prioritization, analysis, possible solutions, and ideas for projects moving forward.

The workshop was held on a weekend to allow the largest number of community members to participate, as most work during the weekdays. The workshop was conducted alongside TECHO volunteers assigned to Santa Ana as they had a long-standing relationship with the community members.
3.3 Bridge Construction

The bridge reconstruction process dates back to November 2018 when initial communication was established with Santa Ana's government. With their help, we were able to identify a problem that we had the capacity to solve, simultaneously using our resources and the resources of the community members. The purpose of our project was described to them as an interactive series of events that would culminate in a solution benefiting all parties involved. Through communication with community members, TECHO Paraguay, and our advisor, Professor Robert Traver, we decided on the framework of our project.

In December 2018, De Carolis and Zuccolillo returned home to Paraguay and visited Santa Ana. This visit allowed them to see the area in person, communicate with inhabitants, and evaluate if there was anything further that we needed to be made aware of before arriving in May to start our project on-site. Their visit served as project assurance and allowed the team to make more educated decisions on how to go forward with bridge construction.

The sketches shown in Appendix A and B intend to demonstrate ideas clearly and analyze the different options handled. Options included using prefabricated concrete tubes or prefabricated ultra-dense plastic tubes. Experts were consulted from a variety of sectors, including professors (Traver and Sakulich), engineer Michael Green, architecture students (Nicolas Sotomayor and Belen Martinez), and former Minister Ramon Jimenez Gaona. Thorough discussion with all parties, as well as an AHP evaluation, helped us come to our final decision. A detailed pros and cons list of each option helped to objectively analyze all solutions. Communications with all parties involved and further presentation to the community of Santa Ana resulted in our final decision to use high-density polyethylene tubes. Using the AHP method, all options were analyzed based on various criteria. It can be a useful method when
weighing multiple design options, considering the advantages and disadvantages the community in which it stands.

### 3.3.1 The Analytic Hierarchy Process (AHP) Method

In order to determine the best possible design for Santa Ana’s bridge, the team decided to utilize the Analytic Hierarchy Process (AHP). The AHP is a mathematical model designed to solve complex multi-criterion decision problems. After deciding the different criteria to consider in the decision-making, the AHP method relies on the judgement of the decision maker to assign weights based on priority for the specific objective. The AHP method transforms these comparison weights, which are often based on empirical judgement, into numerical values that can be easily analyzed and compared (Vargas, 2010). Once the hierarchy of the criteria has been determined, the decision maker can compare the different alternatives by making pairwise comparisons for each criterion. Figure 1 provides a visual representation of how the AHP method works to compare every criterion with every alternative.

![Figure 1: AHP relationship diagram.](image)

### 3.4 Design Alternatives

Using the AHP method, we discovered two different alternatives that fulfilled our project specifications. The two different alternatives included high-density plastic pipes (HDPE) and
reinforced concrete pipes (RCP). High-density plastic pipes and reinforced concrete pipes were chosen because they were previously used for constructions in Limpio. The previous bridge in Santa Ana was built using concrete tubes to allow the water to flow beneath it. However, the bridge was poorly built, and the tubes did not have the required flow capacity to prevent flooding during rainy seasons. Using the information collected, advantages and disadvantages of each design were compared in order to discern the optimal design.

3.4.1 Advantages and Disadvantages of Design Alternatives

The first option for the design of the bridge was the use of concrete tubes. The advantageous qualities of concrete tubes include their resistivity and ability to hold heavy loads. Unlike typical flexible tubes, concrete tubes have the majority of the required strength is built into the pipe, and their success is less dependent on their installation technique (American Concrete Pipe Association, 2019). However, concrete tubes have to be placed on top of a steady, compact foundation. Due to the bridge’s anticipated weight, a solid foundation is needed that won’t yield or cause it to move. If it were to move, a space would form in-between tubes which could potentially lead to erosion. The high weight of the concrete tubes would also complicate the logistics of the construction materials. Machinery would be needed to safely unload the tubes at the project site, adding to the budget and number of outside resources.

The other possible design option is the use of high-density plastic tubes. An advantage of the plastic tubes is that they are available in six-meter increments. Their increased length would potentially eliminate the chance of water leaking through the pipe (Plastic Solutions, 2018). The plastic tubes are relatively light and can be carried by a couple people without trouble. Given the material’s elastic properties, the plastic tubes don’t require as firm of a foundation because they are able to adapt to small deformities (Northeast Consulting, n.d.). The tubes under consideration
can withstand large loads since they are commonly used in infrastructure projects. One disadvantage of using plastic tubes is the price. The plastic tubes are approximately 15% more expensive than concrete tubes.

3.4.2 Professional Recommendations

Before departure, the team conferred with Professor Aaron Sakulich of WPI’s Civil and Environmental Engineering department to discuss the different design alternatives. Professor Sakulich recommended that it would be best for us to focus on the high-density plastic tube alternatives since they would not require us to deviate the water stream. He assured us that after removing the current bridge, the tubes could be placed easily, and water would flow through them.

In our first week here, we were in contact with executives from TuboTec, the company that would be supplying us with high-density polyethylene tubes for the new bridge. Our first meeting was with Michael Green, manager of TuboTec and Antonio Morales, the company’s lead hydraulics Engineer. They led a thorough discussion that allowed us to evaluate each construction scenario, the sketches detailing each scenario are shown in Appendix B. From there, we could make our decision based on cost, time frame, reliability and future improvements. The engineer drew sketches and helped describe the pros and cons for each construction option. One option was to use two nine-meter-long, 88 mm diameter tubes and two culverts made out of the same high-density polyethylene material to stand on both sides. Although this would allow for the sturdiest, and longest structure, it was way out of our budget. The second option was to purchase the two tubes without the culverts, and manually build the walls at the entrance and exit of the bridge. According to Morales, after covering the top of the
tubes with a compacted layer of 40 cm of sand, it would be ideal to place a 30 cm layer of reinforced concrete to give the bridge an even greater load capacity.

3.4.3 Implementing the AHP Method

After discussion with several construction experts, the team determined eight different criteria to consider for the construction of the bridge. The criteria include price, time commitment, facility of logistics for materials, labor requirement, flow capacity, weight capacity, facility for future improvement/enlargement, and reliability.

![Figure 2: Pairwise comparison matrix of the criteria.](image)

The Figure 2 above shows the pairwise comparison matrix between the different criteria. The comparison weights were assigned after taking the resources available for the project into consideration. Comparisons were made using the scale shown in Figure 5 below. Values range from 1 to 5, and their reciprocals from (1/5) to 1.

![Figure 3: Weight scale](image)

As you can see in Figure 4, the weight of each criterion on the vertical axis is equal to 1 when compared to the same criterion on the horizontal axis. For instance, when price is compared to price, their weight is equal to 1. This shows that the two criteria are of equal
importance. However, when comparing price located in the vertical axis with logistics on the
horizontal axis, we can see that the assigned weight is 5. This means that, according to the team’s
judgement, price is five times more important than logistics. The reason behind this is that
money is one of our most limited resources, while logistics is something that the team could
manage to solve relatively easily. It is important to note that when comparing, for example,
logistics in the vertical axis with price in the horizontal axis the assigned weight would be the
reciprocal of when comparing price located in the vertical axis with logistics in the horizontal
axis. Since price to logistics had a weight of 5, logistics to price would have a weight of 0.20
(1/5).

After balancing the matrix, the team was able to determine the priorities for each
individual criterion. The order of priority was: Time commitment (23%), price (20%), reliability
(17%), flow capacity (14%), labor requirement (10%), weight capacity (8%), logistics (4%), and
facility for future improvement/enlargement (3%). The priorities represent the team’s ordering of
criteria. Before arriving to Paraguay, the team deemed the price of the project to be more
important than the time commitment since money was a very limited resource for the team.

However, once in Paraguay, things changed. Due to the rising water level, time
commitment became the most important criteria, which was followed by price. The third highest
criterion is reliability. The team considered the reliability of the bridge to be of high importance.
The bridge will be used on a daily basis by the entire community of Santa Ana; therefore, it must
be safe and reliable. Flow capacity is the next criterion in the priority order. Flow capacity is
important as the lack of flow capacity in the current design drives the need for reconstruction.
Nevertheless, the consideration of all three design alternatives will increase the flow capacity
significantly, which should be more than enough to prevent flooding in Santa Ana. In the fifth
place is the labor requirement for the construction of the bridge. This is an important criterion to consider since the team will be relying on the help of Santa Ana’s community members to help construct the bridge. The weight capacity is the next priority. Similar to flow capacity, both design alternatives are expected to withstand much more than the required load, which is why it lower in priority order. The final criteria, logistics and facility for future improvement, are placed last since they can be managed easily and/or are not entirely essential for the project’s objective.

Once the hierarchy of the criteria is determined, a pairwise comparison matrix has to be made for each single criterion. In these matrices, the different alternatives (Plast. Tubes= High Density Plastic Tubes and PFC= Prefabricated Concrete Tubes) are being compared based on their performance on every criteria. Figure 6 shows the pairwise comparison matrix between the different alternatives when regarding the labor needed for their construction.

<table>
<thead>
<tr>
<th></th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plast. Tubes</td>
</tr>
<tr>
<td>Plast. Tubes</td>
<td>1.00</td>
</tr>
<tr>
<td>PFC</td>
<td>0.50</td>
</tr>
</tbody>
</table>

*Figure 4:* Pairwise comparison between design alternatives in regard to the “Labor” criterion.

Appendix C shows the full AHP model with various different criterion. Following the results obtained from the AHP model, we chose to use the high-density plastic tubes for the construction of the bridge.

### 3.5.1 Plaza Improvements

After listening to community member’s suggestions, it was deemed critical that work needed to be done in the plaza. As the main gathering place in Santa Ana, its enhancement would
improve the living conditions of the whole community. To do so, it was agreed that Santa Ana’s
government would be in charge of cutting the grass and removing weeds during the third week of
the project. During the fourth weekend, the team collaborated with Santa Ana to remove trash
left in the plaza and move all of the discarded tires to a common place so that they could be
recycled. On the fifth Saturday, the team helped plant twenty-four trees in the plaza, received as
donations through A Todo Pulmon, as well as place tires in the plaza perimeter as a boundary.
The next day, Sunday of the fourth weekend, Santa Ana people painted the tires with different
colors. The plaza was now in much better condition than when we held the first meeting. With
Santa Ana’s government it was arranged that the team would provide the community with a
volleyball net and a ball if Santa Ana could come up with the necessary materials to make a
volleyball court, such as posts and lines. The sixth weekend the team donated the net and ball
that added a volleyball court to the plaza. The plaza was now in perfect conditions, along the
lines on how Santa Ana people wanted it to be.

3.5.2 Distribution of Trees

In addition to the 24 trees planted in the plaza, the team distributed trees to each family in
Santa Ana, totaling 150 trees. Walking from house to house, a representative from each family in
Santa Ana was given a total of three trees with the compromise of taking care of them. With
proper care they agreed to provide, we are confident the trees will grow to provide shelter and
improve the quality of life of those in Santa Ana.

3.6 Survey Questionnaire

As an additional deliverable to our project, the team decided to use a follow up
questionnaire. Before conducting the interviews, the team had to submit an IRB application
through WPI (see Appendix E). The IRB application was submitted and approved before the
interviews took place. The survey was comprised of seven questions (see Appendix F). The survey was conducted in Spanish upon the completion of our project and administered to a group of community members. 10 members participated, and their ages ranged from 18 to 59. There were four men and six women interviewed, all representing different families. Deshpande and Jaquith served as the interviewers while De Carolis and Zuccolillo were the note-takers.

Our mission through these interviews was to elicit honest feedback from the community members that we had worked with over the past six weeks. Our hope was that they would share their thoughts and feelings with us about our project so that we could evaluate what they viewed as a triumph, and what they thought could use improvement.
Chapter 4: Results and Discussion

4.1 Bridge Construction

Although the original plan was to reconstruct the bridge after the developmental workshop was completed, an executive decision to build the bridge two weeks into the project was made. Due to the heavy rain flow during Paraguay’s rainy season, we needed to block off enough water to rebuild the base of the bridge. Clear skies were also necessary so that the concrete could dry properly.

The weather indicated it was best to schedule bridge reconstruction for May 24th. Since the change in schedule was abrupt but necessary, it was critical to make sure all of the materials and labor forces were prepared. Materials included soil, large rocks, fine sand, cement, cement levelers, tubes, water pumps, shovels, and extension cords. Labor forces included Santa Ana community members, City of Limpio Municipality, and us. One of the hardest parts about projects with moving parts is making sure that everyone is in the right place at the right time. And even if that proves to be the case, it is inevitable to run into some problems along the way.

Construction started in Santa Ana at 8am on May 24th. Thankfully, the municipality worker was already on site when we arrived. His job was to block off the incoming water one meter beyond the existing bridge on each side. The next step was to start pumping out residual water. Initially, water pumps were used. When they started to malfunction, we used buckets to manually bail out the water.

The second task was the removal of the previous bridge. The backhoe shovel was used to remove the top layer of the bridge and the old concrete tubes. Then, community members manually removed soil at the base of the ditch to make room for the new plastic tubes. Fine sand was laid down at the base to create a compact level bedding for the tubes to lay on.
The fourth task was to place the new tubes into the ditch. After the two 6 m long, 88 mm diameter tubes were delivered by TuboTec, they were lowered into the ditch using wooden slabs as ramps. Finally, soil was dumped and compacted around the tubes to secure their position. Plywood slabs were used to secure the tubes and serve as boundary.

The fifth task was to build walls on both sides of the tubes so that the concrete could be poured. A well-built boundary needed to be in place before pouring the concrete to ensure that none of the concrete seeped through. Large rocks and hand-mixed concrete were used to build the boundary from the ground up in each of the spaces between the ditch border and the plywood slab.

The sixth task was to prepare the inlet, outlet and top of the bridge. Soil was compacted and large stones were placed as a foundation. Machine-mixed cement was then poured on top, using levelers as guides.

When all of the cement had been poured, trowels were used to spread the cement evenly. We joined the community members in placing handprints in the wet cement to commemorate the project. After the handprints were placed, the cement needed to be left to dry for at least 24 hours without interference. We made the community members aware that they could not drive across the bridge for a week and that we would make an appearance the following day to check on the cement’s progression.

When we arrived in the community the next day, the community members had been working on adding the previously removed concrete tubes to each side of the new tubes. They completed this construction using the same methods that were used the previous day. This meant that the final length of the bridge was nine meters and would be sufficient for travel on foot, by motorcycle, by car, and by truck. Since the community members used the old concrete tubes and
leftover cement to complete this task, the additional construction was not included in our final budget. Our final budget is shown below in Figure 5.

<table>
<thead>
<tr>
<th>Provider</th>
<th>Material</th>
<th>Price (GS)</th>
<th>Source</th>
<th>Amount (USD)</th>
<th>Amount(GS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoNu</td>
<td>Arena</td>
<td>1,244,000</td>
<td>GoFundMe</td>
<td>705</td>
<td>4,412,119</td>
</tr>
<tr>
<td></td>
<td>Ventias</td>
<td></td>
<td>Venmo</td>
<td>70</td>
<td>438,083</td>
</tr>
<tr>
<td></td>
<td>Piedra</td>
<td></td>
<td>External Donations</td>
<td>790</td>
<td>4,943,602</td>
</tr>
<tr>
<td>BH</td>
<td>Hormigon</td>
<td>5,600,000</td>
<td>Total</td>
<td>1565</td>
<td>9,793,804</td>
</tr>
<tr>
<td>Tubotec</td>
<td>Tubos</td>
<td>6,945,361</td>
<td>Out of Pocket Cost</td>
<td>638</td>
<td>3,995,557</td>
</tr>
<tr>
<td>Municipalidad</td>
<td>Maquinaria</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAPASISA</td>
<td>Varios</td>
<td></td>
<td></td>
<td></td>
<td>13,789,361</td>
</tr>
</tbody>
</table>

**Figure 5: Bridge-Related Costs and Amount Fundraised**

Although we were not expecting to complete the bridge so early on in our project timeline, it proved to be a success. Participation in construction was high, and both men and women were involved. The eagerness of the community members was instrumental in the bridge construction’s success, as they were both eager to help and to learn. They listened to directions and asked for guidance when needed. Community members also took it upon themselves to delegate tasks based on level of capability and individual skills. When construction was over and the concrete was left to dry, the community members were able to drive over the bridge and use it in everyday life. A photo of the completed bridge is shown below in Figure 6.
Although construction was an overall success, we experienced a few obstacles along the way. One obstacle that we faced were the few breakdowns of the backhoe shovel as the machine struggled with the mass of materials being lifted and transported. Thankfully, the community members were able to work together to fix it. Another obstacle that we faced was that the truck delivering loads of sand got stuck in the mud by the entrance to the community. Thankfully, with the help of the backhoe shovel, it was able to be moved. When the cement truck arrived and saw this predicament, they were afraid that they would experience the same problem. In order to avoid the recurrence, the backhoe shovel delivered the cement load by load, driving from the community entrance to the bridge each time.

4.2 Developmental Workshop

The workshop was conducted on Saturday morning the week following the construction of the bridge in conjunction with four TECHO volunteers. The goal of the workshop was to identify problems, come up with solutions, and put the plan for that solution into action. The 40
or so community members who participated identified a lack of recreational plaza space, a chapel, safe housing, and adequate drainage as their main problems. The plaza issue is something that we were able to solve during our time in Santa Ana. Some of the trees that were donated by A Todo Pulmon were planted in the plaza and painted tires were placed around the exterior of the plaza creating a better atmosphere for community members to gather. A volleyball court was also added in the middle of the plaza which has already led to community members spending much more time in the space. It was great to see the community members take the initiative to beautify the plaza themselves. In terms of a chapel, the community members plan on writing a proposal for fentecho to receive funding from TECHO. Santa Ana has also made progress in improving precarious housing by working directly with TECHO. Lastly, in the case of the drainage issue the community is very dependent on the municipality of Limpio due to the heavy machinery that is needed. Due to this dependency, this issue was not identified as a major priority.

4.3 Plaza Enhancement

Work on the plaza ended up being very impactful. We believe this is because the plaza is a place in Santa Ana that most people use due to its centric location. By having a proper common area, further meetings would attract more people and help in the development of Santa Ana’s identity.

Many individuals, especially women, expressed how much nicer the plaza is now and that they are motivated to do further work on it, i.e. a chapel. Kids were ecstatic about the volleyball court that we also saw them use as a soccer court when we were leaving. A group of men said they were happy because they could use the plaza to do a grill on the weekends,
because the grass was short and well maintained. All of these results were precisely what the team was looking for and we hope the plaza continues to grow as Santa Ana’s gathering place.

The community members identified a lack of green spaces as one of their priorities in terms of changes they would like to see made in Santa Ana. A Todo Pulmon had the resources to make those green spaces a reality. The NGO reached out to us in regard to donating 150 trees to the community. Once the trees were delivered to Santa Ana by the team, they were distributed between the plaza and the community members. Twenty-four trees and plants were planted around the perimeter of the plaza while the rest were distributed among community members. Each family received three plants, and twenty plants were given to San Cayetano, the neighboring community. San Cayetano could use the plants for their plaza, and the donation served as a way to generate collaboration and diminish competitiveness between the two communities.

4.4 Survey Questionnaire

The data we were able to collect through conducting this survey was largely limited by the community member’s level of education and the language barrier. Their first language is Guarani, therefore they were less comfortable expressing themselves in Spanish. Their answers tended to be short and to the point, which is common when less-educated people are being asked questions. However, the team received fairly similar answers from interview to interview regarding their opinion about the project. All of the interviewees stated that they were very content with the bridge and with the project overall. They all conveyed that we fulfilled their expectation.

When asking what their initial thought about our involvement was, we received a range of responses. From the eyes of a middle-aged male community member “There were a lot of
changes. It is important to come and work with people like us. People here lack capacity, and it is good that able people come here to help us.” It was clear, not only in this interview but others, that the community members lack confidence. They know that something needs to be done, but don’t believe that they have the capacity to do it themselves. In the same breath, a female participant also stated that she “Really like the idea of a group of people coming to help us. Our community needs a lot of help.” It is important to notice the difference between the hope that these individuals had, and the more hesitant outlook that a 51-year-old male participant had. He stated: “When I heard you were going to come help us, I didn’t believe it was going to be anything serious. Nevertheless, I kept talking with you because of how much we needed that bridge. When I told the people about you and your project, many didn’t believe that you were actually going to come…Now, after the project, I believe 100% in you and your capacity.” It is clear from his response that his original thoughts towards us were apprehensive. However, as he saw the project come to life, his confidence in our project’s deliverables increased.

This male’s response made us wonder why he was less hopeful than others. His answers to the following questions also provided us with a lot of insight. When asking what we did well, he mentioned the bridge, which was a popular response among the other participants. He said “It was nearly five months since we started talking about the bridge project which used to be only a dream to us. Now, it is a reality.” His response to this question revealed that he was hesitant about potential projects being discussed but never actually happening. That same view continued into the next question about his feelings toward the finished project. He said “Everything improved significantly. Before, the group of TECHO volunteers used to come every Sunday, but not much was being done. With you, things were done.” This response was an interesting discovery, and an important one to make note of. In his eyes, it made a difference
that we provided them with something tangible that they could use in everyday life. His response was similar to another male community member, who stated that “The bridge was one of the best projects that was done in this community and it was done quickly. After almost two months since your arrival, we can see that things were done, and our community improved significantly. The new bridge, in particular, will help us a lot. Now we’ll be able to get big trucks in. Before, large trucks came to help us do things but couldn’t get across the bridge. Now that we have the bridge, we will be able to receive a lot more help.”

Figure 7 reflects the level of involvement of the families surveyed. It is important to note that 50% of the surveyed participants’ families were involved in all of the activities of our project. It should also be noted that 80% of the families surveyed were involved in at least 4 of the 5 activities held, and every family surveyed was involved in at least 2 of the 5 activities.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>Family Size</th>
<th>Initial Meeting</th>
<th>Bridge Construction</th>
<th>Workshop</th>
<th>Tree Planting</th>
<th>Plaza Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>39</td>
<td>6</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>4</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>3</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>3</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Female</td>
<td>44</td>
<td>3</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Female</td>
<td>59</td>
<td>3</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Male</td>
<td>51</td>
<td>5</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Male</td>
<td>51</td>
<td>4</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>4</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Female</td>
<td>18</td>
<td>2</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

*Figure 7: Census of Community Member Involvement*

The last question of the survey revealed what the Santa Ana community members wanted to see done in the future. We expected the majority of interviewees to cite the chapel or better houses as their hope for the community based on the results of the workshop. However, many mentioned a playground in the plaza, improving the community’s main road, and an elementary school. Based on the distribution of responses between the men and women, many of the women wanted a school or a playground that would benefit their children while the men focused on the
improvement of infrastructure. Three of the six females interviewed said that they would like to see a school built in the future, while none of the males interviewed mentioned a school being built. Two of the five males mentioned the gutter system, and one male and one female mentioned a playground for the children. Interestingly, only one female interviewed mentioned the chapel in their answer, and one male mentioned houses being built for those who still don’t have one.

A male participant’s response emphasized the need to finalize the purchase of the land where Santa Ana is currently settled. One of the male participants stated that they “Need help on buying our land. We don’t need the money, but we need people to help us with the negotiations to make them efficient. Once we buy the land, we can do anything. We’ll be able to build the chapel, the gutters, everything. However, if the land isn’t bought, we can risk losing everything.” It is important to note that this is the same 51-year-old male participant who, as previously mentioned, had a hesitant outlook on our project before our arrival. His response to the final question regarding what he’d like to see done in the future revealed that he has more hope going into future projects. He said, “Once we buy the land, we can do anything.” It can be inferred that the outcome of our project has provided him with hope.
Chapter 5: Recommendations for Future Projects

- Foster a relationship with the community members that makes everyone feel equal
- Promote independence/self-sufficiency by leaving as many tasks as possible to the leadership of community members
- Santa Ana can serve as an example for other communities in similar situations
  - If another community needs a bridge, the people of Santa Ana have the tools and knowledge to direct the step by step process in another community
- Project funding should begin as early in the process as possible and be well underway before the team arrives on location
- Tangible projects may be better received by communities than services (because community can see the benefit right away)
Bibliography


• Ayala, S. (2019, March 2). Interview with TECHO Officer [Telephone interview].

Appendices

Appendix A-Prospective bridge construction plans and materials, drawn before arrival to Paraguay.
PLANTA

ALZADO
Appendix B-Construction options and sketches following meeting with Antonio Morales at TuboTec.
Appendix C-AHP evaluation process. Different weights are assigned to different criterion to create a final AHP matrix.
Appendix D-Workshop template used by TECHO Paraguay used to complete a single developmental workshop with Santa Ana community members.
Appendix E-Appendix 1 of IRB Submission including the context, process, and guidelines of the survey questionnaire conducted in Santa Ana.

Santa Ana Survey Questionnaire
Developing Santa Ana Asunción - Paraguay E19
Alejo De Carolis, Akansha Deshpande, Franco Zuccolillo, Isabelle Jaquith
June 22, 2019

Appendix 1

Context:
Santa Ana is a small community in Limpio, Paraguay that was identified to the team as a community in need by TECHO Paraguay. It is home to 53 families of around 5 to 8 members per family, 80% of which are constituted families. Although Santa Ana is located less than 20 kilometers away from the country’s capital, its inhabitants lack several basic services such as water, sanitation, and waste removal. The roadwork in and around the community consists mostly of precarious dirt roads. The condition of the roads, particularly during flooding after rainstorms, impedes the access to Santa Ana and its neighboring communities. Before the team’s arrival, a small, poorly built bridge is the main cause of flooding in Santa Ana during high-raining seasons due to its very limited flow capacity. To prevent this, the team designed and built a bridge that accommodates the required flow capacity to reduce the risk of flooding. During the team’s seven week stay in Asunción, they also visited the community and held a developmental workshop, distributed and planted 150 donated trees, and helped the community members develop a recreational area. The team’s final task is to obtain data on how our project received, both for this project and for future projects.

Process:
Team members will serve as interviewers and will be asking a series of questions to a group of about 20-30 community members in Santa Ana. Each subject will first be asked if they are willing to participate in the questionnaire. Depending on their answer, the interviewer will proceed with the questions found in Appendix 2 below. The interviewee’s answers to these questions will not be linked to their name in any way. The subjects will be asked if they are willing to be recorded. If they say no, they will not be recorded. If they say yes, they will. The answers to the questions will be used to evaluate the effect of the project on the community.

Guidelines:
- If the subject is willing to make their responses public, they must sign a permission slip
- If the subject does not want to make their responses public, we will not disclose any of their information or connect their name to their responses
- If a minor is being interviewed, a closely related adult will be present
- If the subject does not want to participate in the interview, they are not obligated to

Interviewers: Akansha Deshpande (Biomedical Engineering 2021, Spanish Proficient) and Isabelle Jaquith (Biomedical Engineering 2021, Spanish Proficient)
Note-Takers: Alejo De Carolis (Mechanical Engineering 2020, Spanish Native Speaker) and Franco Zuccolillo (Industrial Engineering 2020, Spanish Native Speaker)
Appendix F-Appendix 2 of IRB Submission including a copy of the questions that were asked by the team to the interviewees.

Appendix 2

Introduction:

"Hi, we are a group of four college students who have been working to build a bridge and work towards community development over the past 5 weeks. We are here to ask you if you would be willing to help us in answering some questions. We hope that you are willing to participate. Your answers will remain anonymous and we will keep the information confidential unless you wish for them to be public. We are going to be using a pen and paper to record your responses, as well as a voice recorder if you are willing. Are you willing to be recorded?"

Questions:

1. What is your gender and age?
2. How many people are in your family?
3. In which of these activities were you or your family members involved?
   1. Initial Meeting
   2. Bridge Building
   3. The Workshop
   4. Tree Planting
   5. Plaza Development

4. What was your initial thought about four college students coming to your community to help? Has it changed over time?
5. I am going to ask you questions about the two different groups that participated in this project. I am going to start with the team of four college students.
   What did we do well? What could we have done differently?
I am now going to ask you about your community as a whole.
   What did your community do well? What could they have done differently?
6. Now that the project has come to an end, what are your feelings?
7. What would you like to see done in the community in the future?
Appendix D- Workshop template used by TECHO Paraguay used to complete a single developmental workshop with Santa Ana community members.
Appendix E-Appendix 1 of IRB Submission including the context, process, and guidelines of the survey questionnaire conducted in Santa Ana.

Santa Ana Survey Questionnaire
Developing Santa Ana Asunción – Paraguay E19
Alejo De Carolis, Akansha Deshpande, Franco Zuccolillo, Isabelle Jaquith
June 22, 2019

Appendix 1

Context:
Santa Ana is a small community in Limpio, Paraguay that was identified to the team as a community in need by TECHO Paraguay. It is home to 53 families of around 5 to 8 members per family, 80% of which are constituted families. Although Santa Ana is located less than 20 kilometers away from the country’s capital, its inhabitants lack several basic services such as water, sanitation, and waste removal. The roadwork in and around the community consists mostly of precarious dirt roads. The condition of the roads, particularly during flooding after rainstorms, impedes the access to Santa Ana and its neighboring communities. Before the team’s arrival, a small, poorly built bridge is the main cause of flooding in Santa Ana during high-raining seasons due to its very limited flow capacity. To prevent this, the team designed and built a bridge that accommodates the required flow capacity to reduce the risk of flooding. During the team’s seven week stay in Asuncion, they also visited the community and held a developmental workshop, distributed and planted 159 donated trees, and helped the community members develop a recreational area. The team’s final task is to obtain data on how our project received, both for this project and for future projects.

Process:
Team members will serve as interviewers and will be asking a series of questions to a group of about 20-30 community members in Santa Ana. Each subject will first be asked if they are willing to participate in the questionnaire. Depending on their answer, the interviewer will proceed with the questions found in Appendix 2 below. The interviewee’s answers to these questions will not be linked to their name in any way. The subjects will be asked if they are willing to be recorded. If they say no, they will not be recorded. If they say yes, they will. The answers to the questions will be used to evaluate the effect of the project on the community.

Guidelines:

- If the subject is willing to make their responses public, they must sign a permission slip.
- If the subject does not want to make their responses public, we will not disclose any of their information or connect their name to their responses.
- If a minor is being interviewed, a closely related adult will be present.
- If the subject does not want to participate in the interview, they are not obligated to.

Interviewers: Akansha Deshpande (Biomedical Engineering 2021, Spanish Proficient) and Isabelle Jaquith (Biomedical Engineering 2021, Spanish Proficient)
Note-Takers: Alejo De Carolis (Mechanical Engineering 2026, Spanish Native Speaker) and Franco Zuccolillo (Industrial Engineering 2020, Spanish Native Speaker)
Appendix F-Appendix 2 of IRB Submission including a copy of the questions that were asked by the team to the interviewees.

Appendix 2

Introduction:

“Hi, we are a group of four college students who have been working to build a bridge and work towards community development over the past 5 weeks. We are here to ask you if you would be willing to help us in answering some questions. We hope that you are willing to participate. Your answers will remain anonymous and we will keep the information confidential unless you wish for them to be public. We are going to be using a pen and paper to record your responses, as well as a voice recorder if you are willing. Are you willing to be recorded?”

Questions:

1. What is your gender and age?
2. How many people are in your family?
3. In which of these activities were you or your family members involved?
   1. Initial Meeting
   2. Bridge Building
   3. The Workshop
   4. Tree Planting
   5. Plaza Development
4. What was your initial thought about four college students coming to your community to help? Has it changed over time?
5. I am going to ask you questions about the two different groups that participated in this project. I am going to start with the team of four college students.
   What did we do well? What could we have done differently?
   I am now going to ask you about your community as a whole.
   What did your community do well? What could they have done differently?
6. Now that the project has come to an end, what are your feelings?
7. What would you like to see done in the community in the future?