Prospectus

Hydroponic Crop Cultivation System for Small Island Developing States

(Technical Topic)

Evaluating Technical and Social Failures in the PlayPump

(STS Topic)

By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Implementing technologies in developing communities can be difficult as their societies are developed around already established culture and traditions. This paper will explore and analyze the importance of understanding the users of technology, along with their culture, traditions, religion, and society as a whole, in order to develop a technological solution that is both usable and helpful. It is essential to focus on the humans that are actually going to use the technical device, and to not only understand but incorporate their needs and capabilities into the design of the technology. I will use Actor Network Theory (ANT) to explore the importance of considering both technological and social factors when designing and implementing a solution.

My technical project is looking into a solution to the difficulties of traditional farming in small island developing states (SIDs). As climate change and global warming have caused sea levels to rise, high intensity hurricanes have become more common, especially in North America ("Hurricanes and Climate Change," n.d.). High intensity hurricanes have devastated many SIDs in the Caribbean; wiping out acres of farmland due to extensive flooding and extreme winds. Intense hurricane prone areas like these would benefit greatly from an alternative method of growing food that is protected from storm events, opposed to traditional farming which is susceptible to complete destruction from natural disasters. The technical portion of this report will discuss the development of a design of a storm-resistant hydroponic crop cultivation system specifically created for SIDs. This hydroponic system will serve as a more controlled method of growing food for SIDs. The scope of the design will be further narrowed by performing a Capacity Factor Analysis on both the community in the Bahamas and the proposed technology.

In order to help people in need by creating a hydroponic crop cultivation system, it is important to recognize that the social implications must be evaluated in parallel to the design

process. So often in our world's history, we have seen people develop a "technological fix" for a problem without evaluating the social factors at play (Newberry, n.d.). Without evaluating the social aspects, a technological solution alone can backfire and not truly solve the problem, or worse, make the problem of even greater magnitude. These problems require a socio-technical solution, as they encompass both social and technical aspects. In order to further analyze this socio-technical theme, I will draw upon a case study about the PlayPump. The PlayPump was a technology designed to harness the power of children playing to pump fresh water for their community. However, it ultimately failed due to both technological and social reasons. In this paper, I will use ANT to explore the importance of recognizing both technical and social factors when developing a solution.

Hydroponic Crop Cultivation System for Small Island Developing States

Though hurricanes are a natural part of our climate system, research has indicated that, since the 1970s, there has been an increase in intense hurricane activity in the North Atlantic ("Fifth Assessment Report—Synthesis Report," n.d.). This research also indicates that the number of hurricanes per year is not likely to rise, but instead, there will likely be hurricanes of higher intensity (Webster, Holland, Curry, & Chang, 2005).

On September 1st, 2019, Category 5 Hurricane Dorian devasted the Bahamian islands of Abaco and Grand Bahama (Resnick, 2019). An estimated 90 percent of infrastructure on Abaco, the major agricultural producer for the Bahamas, was damaged or destroyed ("The Bahamas—Hurricane Dorian ETS Situation Report #3 (Reporting period 10/09/19 to 15/09/19)—Bahamas," n.d.) ("Abaco | island, The Bahamas," n.d.). Restoring Abaco to its previous state could take an extremely long time, meaning residents of the Bahamas must import all fresh produce. This will be difficult as Hurricane Dorian also destroyed much of the air and sea transportation

infrastructure. For the citizens of the Bahamas, an alternative source of food could help relieve some of these struggles.

The main form of agriculture in SIDs is traditional farming. However, this method has many flaws; it uses large amounts of water and land, has weather constraints, and is susceptible to bug infestation. These flaws impact both the quantity and variety of crops that can be harvested. However, the main flaw that our technical project aims to solve is that traditional farming is vulnerable to complete destruction from natural disasters. With the continued growth in intensity of storms that we have already seen, it is increasingly important to find an alternative form of agriculture that can survive these events. Without a new solution, agriculture in SIDs, especially those in North America, will continue to be devastated by high intensity hurricanes. This will result in more deaths from hurricanes, and an increase in relief needed to survive their aftermaths.

The goal of this technical project is to use hydroponic crop cultivation to create an alternative source of food production for SIDs, such as the Bahamas. Hydroponic crop cultivation presents a new farming method in which ideal crop growing conditions are established and monitored in a secure, indoor environment. It is not interfered with by weather constraints, bug infestation or other environmental hazards and it uses significantly less water than traditional farming. The specific system the team will develop will also implement a storm-resistant structural design to create a product that can better withstand extreme weather events. Lastly, the system will be able to be easily taken apart, or "fold-out" so that it can be easily transported to islands in need of an additional food production source. Final design requirements for the hydroponic crop cultivation system are still under review as the team wants to ensure the final design accomplishes all of the goals set forth.

In order to proceed with the technical project, the first task is to survey communities within SIDs to determine their current capacity regarding operating the product as well as their desires and needs for a storm-resistant hydroponic fold-out farm. The survey will be formatted based on the eight factors in a Capacity Factor Analysis (CFA); institutional, human resources, technical, economic and financial, environmental and natural resources, energy, socio-cultural, and service. The goal of the survey is to assess both the community and technologies on the same basis. This will allow us to compare their respective capacity factors. This CFA will be performed in the Bahamas in order to determine whether or not a system can be effectively managed. If the community and technology are not aligned correctly, the system has a greater likelihood of failure. The CFA will be completed before a design commitment is made.

Evaluating Technical and Social Failures in the PlayPump

For the STS portion of this paper, I will use the lens of ANT to analyze a case study about a technology called The PlayPump and investigate why this technology ultimately resulted in failure. The PlayPump was designed to bring clean drinking water to thousands of African communities by utilizing the power of children at play (Stellar, 2010). The idea behind the design is simple, a children's carousel-type device is installed and connected to a water pump. When children play, and the carousel spins, groundwater is pumped up into a storage tank above ground, where the water is then available on demand ("How it works—Playpumps | Playpumps," n.d.). This idea was initially developed after its creator, Ronnie Stuvier, saw how retrieving water was usually a difficult, tiring duty that women were responsible for. The goal of the PlayPump was to make this task easier. When Trevor Field, a British entrepreneur, heard about this technology, he bought the patent from Stuvier and went on to install thousands of PlayPumps in Mozambique and other African countries in the early 2000s (MacAskill, 2015).

This seemingly great design ended up not fulfilling the promises that it originally set forth. Some scholars and writers attribute the failure of the PlayPump to technological problems. When the devices were installed, they proved to be inefficient ways of pumping sufficient water for the community (Chambers, 2009). It also failed to address some of the more significant issues regarding water in these communities, such as water scarcity, or water quality (Stellar, 2010).

However, looking solely at the technological problems that the PlayPump faced does not give a full picture into why the PlayPump failed. The technological perspective is limited as it does not consider the social and cultural aspects. It is important to take note of all of the actors involved, and understand the connection between society and technology in this scenario. By only looking at the technological aspects, communities may become disempowered as the solutions they are offered are produced by naïve and ignorant scopes of the actual problem (Johnston, 2018).

When taking a closer look at this case in a social framework, it becomes apparent that local communities were not even asked whether they wanted a PlayPump in the first place (MacAskill, 2015). When these pumps were deployed, children did not play on them enough to provide adequate water for the community. This resulted in village women pushing the carousel themselves, a task they found tiring, undignified, and demeaning (MacAskill, 2015). The Swiss Resource Center and Consultancies for Development (SKAT) found that many women in the communities actually preferred the original hand pumps as opposed to the PlayPumps (Mission Report on the Evaluation of the PlayPumps installed in Mozambique, 2012). Since the creators and marketers did not look deeper into the social and cultural factors associated with these African communities, this technology ultimately backfired. When developers of technologies do

not aim to solve problems both socially and technically, it can result in a waste of technology, funding, resources, intellect, and a loss in quality of life for the users.

I argue that the PlayPump failed not only because of technical issues, but also due to social factors. I will draw upon ANT to organize my analysis of this case. ANT is a framework that examines power dynamics between human and non-human actors in heterogenous networks (Callon, 1987). Considering all of the different actors in the PlayPump network, including the design team, the women who retrieve the water, the children who play on the device, and the pump itself, is essential to understand why the PlayPump ultimately failed.

Conclusion

The technical portion of this report will ultimately result in design specifications for a hydroponic crop cultivation system for SIDs. The design will be storm resistant in a way yet to be finalized. The purpose of the design is to provide SIDs with a new alternative to traditional farming, one that can provide nutritious foods in times of emergency and/or be used as a source of income.

The STS portion of this report will investigate further the need for engineers to function as engineer-sociologists and the importance of considering both technical and societal design in order for a technology to be successful. In order to accomplish this, I will use ANT to analyze a case study about a failed technology called the PlayPump. The combination of my technical and STS research will allow me to offer a solution to this socio-technical problem that proposes how engineers can move forward in creating more compelling and all-encompassing solutions in developing countries that look deeper than just the technological fix.

***Word Count** = 1865 words*

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