From Students to Social Entrepreneurs in Ifugao, Philippines
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ABSTRACT
This paper outlines the effect of certain programs, individuals, workshops, and academic as well as in-country experiences on the entrepreneurial spirit of young students. It focuses on two students in particular who became involved in a micro-hydroelectric rehabilitation project funded by NCIIA. This led to their further involvement in development projects and continuing interest in combating global problems through innovative engineering solutions and social entrepreneurship.

Through these experiences, our students have learned many things about social entrepreneurship, community engagement, and approaching problems people face when living in poverty in the developing world. Through various NCIIA funded programs, these individuals have developed from students into confident entrepreneurs motivated to solve the problems of today’s world.

Introduction
Diane Tamir began her college career at Villanova University in the fall of 2007 as a mechanical engineering student. In her sophomore year, she began the track for the new Engineering Entrepreneurship minor and was in the first class of students to graduate from this program. Through this minor, she was introduced to Dr. Pritpal Singh, a professor involved in both the entrepreneurship minor and the NCIIA-sponsored initiatives in the Philippines. With the encouragement of her professors, she traveled to the Philippines in the summer of 2009 as part of an assessment team looking to find local entrepreneurs with local solutions. The following spring, along with Mahmoud Kabalan, an electrical engineering Master’s student, she attended the Advanced Invention to Venture (AI2V) workshop at Stanford University, where they worked on a business model for a micro-hydroelectric system in a rural village in the Philippines. That summer, both Mahmoud and Diane traveled to the Philippines to work on the implementation of the system.

In the 2010-2011 school year, Mahmoud and Diane put together a business plan for a potential 1MW hydro-electric system in the Philippines and looked to investors for $3 million in capital. However, to their surprise, they found more interest in small scale rural systems. Diane then spent the summer of 2011 at an International Development Design Summit in Ghana also working on rural electrification. Upon her return, Diane and Mahmoud received an investment from Halloran Philanthropies supporting a six month assessment trip to the Philippines with the goal of identifying a rural village with the potential to sustain a new and complete small scale hydroelectric power generation system. Diane and Mahmoud are currently planning their upcoming trip in January using the tools and lessons they have learned throughout their academic careers to prepare them for what’s ahead.

Engineering Entrepreneurship Minor
The entrepreneurship minor program provided the basis for all the development and design projects that Diane has worked on. She has found that understanding basic business concepts has helped her in unexpected situations and has given her an upper hand in various projects. Looking at design from a business perspective is not in an engineer’s training, but is necessary and extremely valuable in any kind of innovation.

The minor provided the background needed to hold a business planning workshop in the Philippines for local entrepreneurs, which led to Diane’s greater understanding of the local culture of business. Without this foundation, all the other business workshops and seminars she
attended would have just scratched the surface instead of compounding into a more thorough understanding of business and entrepreneur. The minor also helped in the identification of projects, providing the basis to know which ideas are worth pursuing.

Micro-Hydroelectric Rehabilitation Project in Ifugao, Philippines

Background

Ifugao is a landlocked province in the North of the Philippines on the island of Luzon. It is located in the Cordillera Administrative Region and is about an eight hour bus ride from the capital city of Manila. The main source of income in Ifugao is farming. It is composed of 11 municipalities with a total population of less than 200,000, making Ifugao one of the least densely populated provinces of the Philippines.

Ifugao is particularly known for its rich indigenous culture, mountainous terrain, and vast rice terraces, which were hand carved into the mountains thousands of years ago. These terraces and the practices used to farm them have become essential to the culture and history of the people of Ifugao, shaping their beliefs, practices, and rituals. The terraces were identified as a UNESCO World Heritage Site, and since then a tremendous amount of energy has been devoted by local organizations to encourage the residents to preserve and fully cultivate the terraces.

Unfortunately, the land in this area has not been fully cultivated due to a lack of farmers. As the youth grow to a working age, they choose to move to the cities to find a better way of life. This keeps the average age of the community very high and prevents the indigenous knowledge, practices, and culture from being passed down. Terraces have begun to erode, and the farmers cannot stop focusing on their other crops to devote enough time to fix them, causing even more erosion. The Philippines is also the largest international importer of rice, despite all of the agricultural land dedicated to the growing and production of the crop. These empty terraces represent a significant amount of economic potential for the production and sale of rice throughout the country, with increased production. The only issue is making living and working in these areas more attractive so that people will stay in their communities and cultivate their land.

Twenty million, or over twenty percent, of Filipinos are still without electricity, many of whom live in remote rural communities far from any chance of being connected to the grid. The cost of electricity in Ifugao is the highest in the nation, ranging between 9 and 14 pesos per kWh (Manila averages around 6 pesos per kWh). This is primarily because of the challenging terrain and the generally low loads of electricity. Local utilities also cannot afford to build distribution lines to the small rural villages because it is not economically viable, since these households can only afford "lifetime rates" or less than 1kWh per month. This leaves rural electrification projects in the hands of the local government, which is the only entity that can afford it. However, the government gives priority to road construction and community center development over electrification projects for villages with small populations.

Studies by the Philippines Department of Energy show that there are 51 sites in the province of Ifugao alone that have the potential to generate 25kW or more. Many of these sites are near rural communities with no or low quality electricity. This abundance of water within the individual rural villages shows promise for the communities to generate their own electricity rather than wait for the government to secure funding to connect them to the existing grid.
Assessment Trip

The ongoing efforts in the Philippines began with an assessment trip in the summer of 2010. Through an NCIIA Sustainable Vision grant, a group of Villanova faculty and students from the Engineering and Business schools traveled to the province of Ifugao, Philippines with the goal of identifying local entrepreneurs with innovative solutions to local problems. During this time, a partnership with the Save the Ifugao Terraces Movement (SITMo) organization was developed which continues to this day. With their help, two local innovations were identified which brought forth two senior design projects for Villanova mechanical engineers.

The first innovation was from entrepreneur Fernando Bahatan, who built a lemongrass distillery from local resources. His solution was based on how it was much easier and cheaper to transport small bottles of concentrated oil rather than entire batches of lemongrass (required to extract a small bottle’s worth of oil). He discovered that his customer base expanded when he was able to sell the lemongrass directly to the user, and he could also sell this processed form at a much higher rate. He then developed a cooperative around this distillery, selling lemongrass oil mostly to local restaurants and masseuses in nearby tourist areas. The senior design project focused on increasing the efficiency of the system at an affordable price, so that Mr. Bahatan could make more oil in less time using less fuel.
The second innovation was by Louis Cabbigat, who installed a micro hydro system in the remote village of Maggok in the province of Ifugao, Philippines, providing electricity to over 100 homes. However, ten years later, the system was in disrepair, leaving the households with little to no electricity and frequent blackouts lasting weeks at a time. This motivated the second senior design project, which was a rehabilitation of the micro-hydroelectric system in Maggok. (Please see last year's NCIIA paper for more details.)

Summer Internship
In the summer of 2010, three interns (Diane along with two students from the Villanova School of Business) were hired to spend two months in the Philippines working with our in-country partner organization, SITMo. During this time, the interns focused on two main goals: managing the implementation of the micro-hydroelectric system along with organizing the cooperative running it, and working with the five new Community Learning Centers (CLCs) to develop business plans to help them sustain the centers. This included holding a three-day workshop on business planning, which brought local entrepreneurs and leaders together from different parts of the province.

Through this workshop, the interns worked with the CLC management teams to identify potential markets, local resources, and possible streams of revenue. Once those were identified, the interns coached the teams with the assistance of business students from the local university to put together a plan of execution including processing, marketing, selling, and bookkeeping aspects.

At the end of the summer, a team of engineers and business students joined the interns. Among them was Mahmoud Kabalan, who focused on the design and manufacturing of a load controller for the micro-hydroelectric system and a redesign/upgrade of the electrical distribution system. The team also included a recent engineering graduate focusing on the implementation of his senior design project on lemongrass distillation, and two current engineering students looking to identify a new project for their senior design team with Diane.

Through this internship and especially during the workshop, much was learned about the business attitudes and know-how of the community. Since there was such a range of individuals attending the workshop—from farmers with as little as some primary education to college graduates who run their own businesses—we could get a complete scope of the knowledge possessed in the province. We learned that it was more about the individual and how motivated they were rather than the level of education they received. We also saw that there were many things which seemed obvious to us that were not obvious to them and vice versa, meaning we could learn a lot from each other. This demonstrated that these projects needed to have a collaborative effort or else something inevitably would go unaccounted for. With little economic activity in place, businesses needed to start at the most basic level, with high consideration for cultural practices and everyday habits.

Current Conditions
Following the student internships in summer 2010, local manufacturers in Manila were identified and contracted to fabricate the turbine and load controller. Since then, the turbine has been fabricated and installed in the micro-hydroelectric plant. Renovations have also been initiated on the power house, but are pending further funding. A new electrical load control and generator have been purchased to be installed by the end of 2011, along with a new electrical distribution system.
Lessons Learned
The rehabilitation project in Maggok took much longer than projected, by almost an entire year. The majority of the delays were unex-
pected; however, some roadblocks could have been foreseen.

The culture in the Philippines is very different than that in the US in social, business, and government settings. We realized that in a dif-
centure, we cannot expect things to go at the same speeds that we are used to. Furthermore, we should have planned accordingly and
realistically, taking this into account in the timeline. In the future, we will assume in advance that everything will take at least 20% longer
than we would like. A backup plan is also needed for all crucial milestones in the timeline. If many things are dependent on one milestone
that is not guaranteed to be on schedule, we should put other routes in place to complete the crucial item if our first option fails.

In addition, the funding was not sufficient for what was needed. At the start of the project, our assessment was that only the turbine, gen-
erator, and powerhouse needed to be rehabilitated. However, as we progressed we discovered that there were many other problems with
the system, including the intake canal and the distribution lines. Some of these problems were so bad that even if the turbine, generator,
and powerhouse were completely revamped there would have been no change in the actual electricity received by the community. There-
fore, in order for the community to benefit from the changes that were made, more funding needed to be secured in order to repair the
other failure points in the system. In conclusion, a full analysis of all aspects of the system including all internal and external factors should
have been completed at the start, even if only a portion of the system was to be rehabilitated.

With insufficient funding also came political issues, which slowed down the entire project in addition to the unexpected problems. There
was also no one entity that worked on the project for its entirety. Our team went from being directly involved during the times when we
were on the project grounds to being remotely involved when we were back in the US. The partner organization was focused on a few on-
going projects at the same time, and as the funding diminished and the timeline stretched, the project took less priority in all our efforts.
There should have been at least one person whose undivided attention was focused on this project from its identification until the system
was fully functioning and operational.

Furthermore, the community was not involved in the planning, implementation, and progression of the project. A cooperative was set up
to run and maintain the system, but they were not given enough training and guidance to successfully run and maintain the system for
years to come. They should have been involved with the project from the assessment phase and should have been more accountable for
the efforts to push it forward. Instead of doing everything for the community, its members should have been given more responsibility
and ownership, pushing them to understand the system, handle it properly, and utilize it to its full potential.

International Development Design Summit, Ghana
In the summer of 2011, Diane spent five weeks at the International Development Design Summit (IDDS) in Kumasi, Ghana. During this
time she worked with a group of engineers from all over the world on small scale electricity generation through gasification of agricultural
waste, specifically corn husk.

The summit began with a crash course in how to address problems in a developing community and implement sustainable, practical, and
worthwhile solutions. The approach emphasized co-creation or working with the community to develop products that will be useful to
them, involving the community throughout the entire design process.

Attending the summit were 70 to 80 participants from around the world carrying thousands of different perspectives, success stories,
lessons learned, and words of wisdom. This created an environment where everyone had the common interest of tackling the problems
they saw instead of waiting for them to fix themselves. The students who attended became aware of the larger community sharing this
common passion and of many efforts made by other students and individuals at different universities and around the world. Through this
network, participants were able to share their projects and verify their ideas. Participants were instilled with a motivating spirit that lasted
much longer than the length of the summit.

Being exposed to communities of radically different cultures also helped to connect the dots between the underlying issues and common
problems found in poverty-stricken areas. The more communities visited, the more equipped innovators are to tackle common problems.
However, since not every culture has the same approach to similar issues, universal problems may not always have a universal solution.
Furthermore, nothing compares to working with the specific end-users and customers to develop a product that will truly be valuable to them.

Identifying Opportunities
NCIIA AI2V Workshop
In the spring of 2010, Diane and Mahmoud, along with three Villanova professors, attended the AI2V workshop organized by the NCIIA at
Stanford University. During this time, we developed a business plan for the Maggok Sustainable Electric Cooperative (MAGSEC), the orga-
nization running the current micro-hydroelectric system in Maggok.

Through many helpful tools explored during the three long days, our assumptions were tested and many were proven wrong. We dis-
covered both the invalidity of our original plan and the enormous potential for electricity generation through hydroelectric power in the
province of Buga. What we learned during this time gave birth to a new and improved business plan around a much larger system which
addressed many of our concerns.

The plan was for a 1MW system at a location closer to the main grid and a paved road. It was less populated and had a better geographical
profile; however, it required $3 million in investment. Although it had a payback period of about five years, it would continue to produce
steady and high returns for up to 25 years if well maintained. After a year of development, this business plan was taken to investors in search
of funding for an initial assessment.

Upcoming Plans
In the fall of 2011, Diane and Mahmoud received investment from Halloran Philanthropies for a six-month assessment phase. However,
this funding was not for the assessment of a 1MW system, but instead to explore the possibility of installing a complete micro-hydroelec-
tric power system in a completely un-electrified remote rural village.

In the past few months, Diane and Mahmoud have developed a new plan with a different approach developed from their many experi-
ences. Focusing on community engagement and the long term sustainability of the project, their approach is to provide a complete pack-
age based on social, economic, and technical aspects to ensure that the community will not only benefit from the electricity but be able to
sustain the system and stimulate their local economy. They aim to empower the community with the tools to raise themselves out of
poverty by working with them to implement the clean energy system and by treating communities as equal partners as opposed to recipi-
ents of charity. Giving the community the responsibility for their own development ensures the sustainability of the system once the team
leaves the ground. By then, the system should be completely locally maintained and operated. The community will have everything they
need to not only sustain the energy system, but to expand the entrepreneurial activity within the village, using electricity as an enabling
technology. They will be equipped with the right tools to develop to their full potential, with organizations and methods to monitor their
progress and facilitate their growth.

Conclusions
Throughout their academic careers and through networking with other more experienced individuals, such as Khanjan Mehta of the
Pennsylvania State University and various NCIIA experts, Diane and Mahmoud have acquired many tools to assess their efforts that have
been proven very helpful. Some of these tools include life cycle analysis, value chains, Khanjan’s E-Spot canvas, and Alan Smith’s Business
Model Generation Canvas. Since all people involved in or affected by the project must be considered, they also learned how to identify key
stakeholders and how to determine on what level to engage each one.

These two students have come a long way in learning about social entrepreneurship. Through these experiences, they have developed a
more holistic approach when it comes to analyzing problems and resources in a community and designing solutions. They learned that
although simplicity is key, it is rarely as straightforward as it seems and in every change made there are winners and losers. Nothing stands
completely independent. The whole system and potential ripple effects must be analyzed. If new resources are used for a new design, it
may be because they are taken away from another system. If a new revenue stream is tapped into, someone else might be losing money.

In this context, the technology should be simple but the implementation probably will not be. Although the trend in addressing problems
in the developing world is charity, social entrepreneurship tackles those problems in a new and more sustainable way. Since there is not
much, if any, value in a product that no one is willing to pay for, a product that is invested in by the community is much more likely to be
taken care of.

Culture might be the most important consideration when trying to implement a design. Learning about a community is critical in terms of
providing a product that will benefit them. The right questions should be asked, such as “what problems or difficulties do you have every
day?” instead of “what do you need?” Furthermore, the problem or need for the product at hand must be verified to ensure that you are not
just designing something that you would like if you lived in similar conditions, and that you are not just implementing something that
the community thinks they need but won’t actually use. This makes the concept of value a very important one, and students must learn to
identify value and be able to instil it in the final product.

NCIIA 16th Annual Conference

NCIIA AI2V Workshop
Learning about the culture also brings out many hidden issues that may play a major role in the success of your project. This can help you determine how the product will affect the community and what can happen down the line. For example, examining how long a system will last may prevent the community from being worse off in a few years when they cannot fix a product that they now depend on. Examining the customer profile may prevent tension in the community if only the more privileged can purchase your product.

These are just some of the tools, lessons, and experiences that two of our students have gained through NCIIA-funded programs that have empowered them to do better, more effective work on the projects they are now involved in. Opportunities present themselves every day, especially in developing countries where problems abound. With the right tools and training, students can not only be equipped to notice them, but capable of doing something about it.

References
