A 21st Century Approach to Solving Water Poverty

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Abstract

Water poverty is a complex problem that is caused by two major factors amongst other factors, one is the lack of appropriate technology, and secondly it is compounded with an affordability crisis resulting in 783 million people lacking access to clean drinking water all over the world. This paper discusses how new age business practices can help create better products and high impact to eliminate water poverty. Methodologies including Lean Start-up, social business models and Triple Bottom Line have been discussed and applied to create consumer-focused products by incorporating consumer feedback at the prototype stage. This allowed development of key criteria in order to produce appropriate technology for consumers in rural areas of the developing countries with low purchasing power. The business development is made possible by social business model that allows high level of collaboration between small companies and industry leaders like Grameen as compared to a much more competitive conventional profit based business model. Based on success of these business models in other fields and their similarity to water sector, they can create high impact in water poverty sector. Key findings include the product development thus far leading to lower price points with better usability than the competitors by focusing on process modifications and incorporation of a holistic approach.

Keywords: Water Poverty, Solar Still, Lean Start-up, Social Business

1. INTRODUCTION

As per the UN research, water scarcity affects 40% of the global population. An estimated 783 million people do not have access to clean drinking water. Unclean water is the main source of diarrhea and dysentery and the leading cause of child mortality in rural areas globally with over 1.5 million deaths annually. On the other hand, solving water poverty results in high return. UN Research shows that every US $1 invested in improved water and sanitation translates into an average return of US $9. Those benefits are experienced specifically by poor children and in the disadvantaged communities that need them the most, as mentioned in reports by United Nations (2017).

Water is utmost vital for sustaining life. With increase in global warming, the fresh water sources are depleting at a higher rate than anticipated. Year after year area of arid regions has been constantly increasing, which was determined by World Water Development Report (2016). The freshwater sources have also been left undrinkable due to excessive dumping of untreated waste. This affects not only the environment but also human health.

Wassouf *et al* (2011) discussed that groundwater is extracted as the surface water depletes faster than it is naturally rejuvenated. Though there is no severe water shortage, there is a dire need to address the growing demand and the stress on the existing water sources. The most common desalination process currently in use is reverse osmosis, which is an energy-intensive process. Most of the inland freshwater need treatment to filter out the dissolved toxins and microbes before it is deemed fit for consumption as stated by Young (2017). The current supply is already a deficit of the demand, and the gap will further increase in future.

Many of the existing processes are either capital intensive or energy intensive. People in the arid regions and rural areas cannot afford these systems.

To counter the energy-intensive processes, we can use solar energy to treat the water. The biggest advantage of solar energy is its infinite availability and zero fuel cost. Distillation process has been utilized since ancient times with references made by Aristotle as early as 4th century BC. Young (2017) also reiterated ths distillation process, it involves evaporation of water from the impure mixture and condensing the vapour to retrieve water, which is fit for human consumption like the process nature makes rain. The energy and cost-intensive processes are compromised by the low output observed of this process since evaporation and condensation are not fast processes. Though the technology is not new, the effort has been made to develop a product that makes use of this technology and bring it for the rural communities for whom affordability is a higher priority than system efficiency.

On understanding the prevalent barriers hindering the solar still technology from becoming mainstream it was determined that the key factors involved were cost, payback period, and most importantly low efficiency. However, considering the current scenario where there are millions of people especially in the remote areas of developing and underdeveloped nations who do not have access to clean potable water; this technology in its current form could help ease their life and improve their health tremendously.

2. TECHNICAL DETAILS

Almost all the active research that has been undertaken has been from the perspective of enhancing the solar still efficiency. However, the approach applied in this paper for the implementation of this technology, that makes it unique, is to bring forth for the masses in the most economical and effective way.

The core concepts that have been implemented in this project are based on the existing proven research. The best and cheap methodologies that help improve the system efficiency without compromising on the affordability of the target consumer have been incorporated.

Furthermore, the process improvement is the focus of the project. To bring the product to the target consumer at affordable cost optimizations from the perspective of logistics, usability, and maintainability in the design have been made. Adhering to the principle of concurrent design any issues that may arise from the prototype will be addressed.

The core system design is addressed to efficiency enhancement by means of studying the effect of glass inclination, encasement material, base insulation, wick type, water column depth, chamber height & volume, charge flow-rate, the effect of chamber humidity, pressure, water salinity on the rate of evaporation, these were adopted from Wassouf *et al* (2011) and Naim and Abd El Kawi (2003). Selective compromise has been made in the overall system efficiency and area covered by the module to achieve the target yield of water production. Keeping in mind the key demographic, the economics of this project is vital.

2.1 Alternatives Comparison

The existing alternatives for securing potable water include purchasing bottled water, water filters and Reverse Osmosis systems.

The market study by Numbeo (2017) suggests average cost of bottled water in developing nations such as India, Pakistan, Bangladesh, Cambodia, Peru & Nigeria vary in the price range of 0.4 to 0.8 A$/L.

One of the alternatives by Unilever (2017) is non-electric gravity-based membrane water purifiers that produces water at the cost in the range of 0.004 to 0.006 A$/L as stated in their pricing. Though cheaper, the membrane performance is limited based on the turbidity of water. The filter life reduces exponentially when using highly turbid and saline water, thereby resulting in a more expensive solution as discussed by Wilf (2008).

The Reverse Osmosis systems are more feasible for large-scale production based on the process complexity and capital requirement. The portable Reverse Osmosis systems do exist; however, they need an additional powering unit for operation and require trained workforce for maintenance, resulting in an overall expensive solution.

The target production for the system discussed in this paper is 10 L/day at the unit cost of $100 with a life of at least 5 years. This results in 0.0055 A$/L cost of distilled water. The solar still when pitted against the alternatives outshines its cost benefits.

3. SOCIAL ENTERPRISE BUSINESS MODEL

Implementation of social enterprise business model has proven to be one of the most effective systems to create impact in the modern age. According to Nobel Laureate and social enterprise pioneer, Dr Muhammad Yunus (2010),
"Social business is a cause-driven business. In a social business, the investors/owners can gradually recoup the money invested, but cannot take any dividend beyond that point. Purpose of the investment is purely to achieve one or more social objectives through the operation of the company, no personal gain is desired by the investors."

A purpose-based approach also allows companies to work in collaboration more than the traditional business practices. Skarya *et al* (2012) discusses the collaboration opportunities in social business as two companies with similar or complementary purposes can collaborate to achieve their specific purposes rather than compete with others. As an implementation of this methodology, Water Democracy also intends to collaborate with Grameen Foundation and other industry leaders by incorporating successful micro-credit finance scheme for people to purchase their products and get access to clean drinking water. A utilization of existing distribution channels also greatly reduces the company's cost of establishing channels in the target markets. This is made possible by social enterprise business model where competition can be replaced by collaboration.

3.1 Triple Bottom Line

A commonly applied practice for social enterprises and social business is Triple Bottom Line. It takes into account Financial, Social and Environmental aspects of the company equally. It is unlike traditional businesses where financial bottom line is the one that matters the most. An application of triple bottom line has allowed multiple social businesses to succeed while creating impact as stated by Hall (2011).

3.2 Lean Startup Methodology and Exponential Growth

Lean Start-up Methodology by Reis (2011). is a tried and tested method that has worked successfully in the IT industry for a long time now and has resulted in exponential growth for multiple companies as stated by Moogk (2012). One key example is the rise of Facebook.

It follows simple principles of validating a company's ideas by incorporating consumers input and measuring the input before execution as stated by Reis (2011). It is a basic scientific principle; however, this has only been applied recently as an official business practice. Lean Start-up Methodology and its effectiveness are also applicable outside of IT world as seen in the success of many companies, one of the examples is GE's energy storage division, discussed by Blank (2013)

where they came back to customer focus, inquiring about customers and then delivering the product and planning. The first step is the customer and the last step is customer's feedback and validation.

4. PROPOSED BUSINESS MODEL AND CONCLUSION

A combination of Social business practices compounded with triple bottom line accountability and lean start-up methodologies for growth resulting in an exponentially growing high impact social enterprise in any sector as in for profit sector. Incorporating consumer feedback at the design and prototyping stage enhances chances of success as well as save scarce funds that might have to be spent in later stages. Triple Bottom Line makes sure that the company is accountable in all aspects while a social business model ensures that the company is focused on impact and open to collaboration.

Implementation of these methodologies resulted in three key criteria for products to be developed by the project for the rural customers in developing world.

4.1 Key Criteria; Simple, Robust and Cheap

These three criteria have been selected as the foundation of technological development at Water Democracy due to the target market.

Simplicity allows easy maintainability and contributes to the longevity of the product. A simple enough product makes it easier to train people to maintain it overcoming a barrier in promotion of social enterprise at a local level.

Robust products reduce the breakage and going against a market trend of planned obsolescence to provide consumers with longer lasting products and reduce cost of impact.

Low Prices is a key criterion due to the target market. Only cheap enough products can succeed in the above stated markets, since even cheap products require assistance via micro credit.

Execution of simple designs also allows flexibility in terms of hybridization and add-ons. This improves the aspect of reach in terms of targeting higher level of economic demographics to help cross subsidize the need-based customers.

The application of above principles has showed the trajectory of achieving the same water purification yield at a much lower price point as our competitors making solar still.

CONCLUSION

With high level of success of social business models in multiple sectors, it is important that even engineering companies place a high priority at developing a holistic business model that incorporates customers' needs from an early stage. Development of a dynamic social enterprise that is able to adopt to and operate in multiple different cultures in cooperation with local partners and is self-sustaining, is needed to tackle challenges. With the increasing stress on the current water sources due to rise in population and climate change impact, it is quite imperative to address the concerns affecting millions of humans all over the world with solutions developed with 21stCentury approach. Amongst other methods a key part of the solution for water poverty is business that cane quickly developed products based the key demographics identified with local partners and their experience such as a Solar Still. This is presented in the form of Water Democracy; a social business enterprise that develops customer focused products, follows Triple Bottom Line and is driven by impact while simultaneously able to sustain itself without relying on charity.

ACKNOWLEDGMENT

We would like to acknowledge the guidance provided by Mr Mahfuz Ashraf from University of New South Wales in providing significant guidance from local knowledge and experience in development of successful social business in the developing world.

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