THE PAPER BLOCK PROJECT

IMPROVING THE DESIGN AND IDENTIFYING MARKET OPPORTUNITIES FOR A SUSTAINABLE COOKING FUEL IN KATUTURA, NAMIBIA

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Paper Blocks: Improving the Design and Identifying Market Opportunities for a Sustainable Cooking Fuel in Katutura, Namibia

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Sponsoring Agency**:** Men on the Side of the Road

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Abstract

Our project advanced the uptake of a sustainable firewood alternative in the informal settlements of Katutura, Namibia. The small business enterprise of a burnable paper block will reduce unemployment and combat desertification. We worked with Men on the Side of the Road (MSR) to improve upon the paper block's performance and created a new business model to promote its use. We conducted interviews with the local community exploring the current domestic fuel use, tested old and new versions of the paper block, and determined how it could best be brought to market. We created a new block design with improved burning capabilities, trained local MSR members in its production, and developed a viable community business model.

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Executive Summary

Due to lack of opportunities in the rural areas of Namibia, many people have migrated to the capital city of Windhoek in search of jobs, better schools, and access to medical care. Most migrants end up living in the informal settlements in Windhoek, which are characterized by tin shacks, a lack of running water, electricity, and indoor sanitation. Plagued by a lack of education and marketable skills and coupled with a saturated job market, many migrants are unable to find full time employment in Windhoek.

To meet daily cooking needs, people struggle to afford a source of fuel. Electricity is intermittent and only partially available, and few people can afford gas or kerosene, locally known as paraffin, on a regular basis. Most people collect or buy wood as their main source of fuel for cooking. As a result, many trees have been cut down for this purpose over the past few decades. The over-consumption of wood has led to many environmental and social issues, most notably desertification, which is defined as "land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (*United Nations Conference on Environment and Development*, 1992). Desertification leads to less arable land which can cause food shortages and have other climatic consequences.

We worked with Men on the Side of the Road (MSR), a non-profit organization established to combat unemployment by linking unemployed citizens with work and training opportunities. In 2011, MSR developed an alternative to firewood, from recycled paper and sawdust. The goal of this project was to develop a source of employment and income for local residents as well as combat desertification through the production and sale of the paper block. The product was manufactured, but there was substantial resistance in the market to adopting the block as an alternative fuel source.

In order to assist MSR with the Paper Block Project, our team aimed to understand the perception of local residents about the paper block, develop a better product, and create a business plan that is feasible and socially acceptable. We set forth eight objectives to accomplish our goal.

1. Gain an understanding of current cooking methods in Katutura
2. Understand how the paper blocks compete against other cooking fuels with respect to cost, performance, convenience, suitability, and safety

3. Identify the current perception of and potential demand for the paper block by the general public
4. Identify the product quality and propose an improved design for the paper block
5. Understand how local residents share information through social networks, specifically from the perspective of small enterprises in Katutura
6. Assess and identify the strengths and weaknesses of the past marketing plan for the paper blocks
7. Develop a new marketing plan and sales model for the paper block
8. Train and empower local individuals to continue the project in the future.

We visited four different communities and interviewed 25 local residents. To gain a general understanding of the current cooking practices in Katutura, we asked the residents about the fuel types they use, where and how they get their fuel, as well as how much the fuel costs. We found that the majority of people cook over an outdoor wood fire. Besides using branches of dead trees, people also use pallet wood and similar scrap wood when it is available. Some people also use paraffin or a gas stove to cook when it rains or when they make light meals. While some residents spend five to seven hours walking to forests or farms to collect dead branches, some take a taxi or rent a car. Others who do not use much wood or do not have time for this chore, choose to buy wood from local street vendors. Depending on the meals they cook, community members spend approximately 5-10 Namibian dollars (US $0.50 - $1) on wood to make each of their meals. We learned that this price has increased in the last few years as wood has become harder to find.

Figure 1: Havana community in Katutura, where residents live in shacks

While we were in the informal settlements, we identified seven families to pilot test the original paper blocks to understand the current opinions of community members towards the product. We gave them ten to fifteen blocks with varying compositions to test and revisited them after a week to ask for their feedback. The major drawbacks that they reported included that the block produced a weak, fickle flame that could not be used to cook, and that the block produced too much smoke and ash. In order to address these concerns, we conducted a comparison study between wood and the paper blocks to evaluate the product quality. The results from the testing showed that the paper block, in its current state, could not compete against other cooking fuels in the market. Our team determined that in order to improve the performance of the block we needed to decrease compression, increase the surface area to volume ratio of the blocks, and increase the airflow to the block. To accomplish this we developed a new design for the paper block that was thinner and featured two parallel holes running lengthwise through the center of the block. The new design we developed, along with the original design, can be seen in Figure 2 and Figure 3 below.

Figure 2: Original design of the paper block

Figure 3: Newly developed physical design of the paper block

These changes improved the performance of the blocks significantly in two major categories: heat output, and time to reach maximum temperature. We found that a block with the new physical design and a composition of two parts paper to one part sawdust, was our best block and performed comparably to firewood. We found that paper blocks with the old design were able to raise the temperature of one liter of water by 27.8°C compared to our best new blocks, which raised it 32.1°C, and firewood which raised it 44.6°C. While wood was able to

reach a higher temperature, it took much longer to do so. Looking at the temperature increase per minute, our best block performed best at 4.75°C/min while the old design blocks and wood performed at 1.17°C/min and 1.78°C/min respectively. These comparisons can be seen visually in Figure 4 and Figure 5 below.

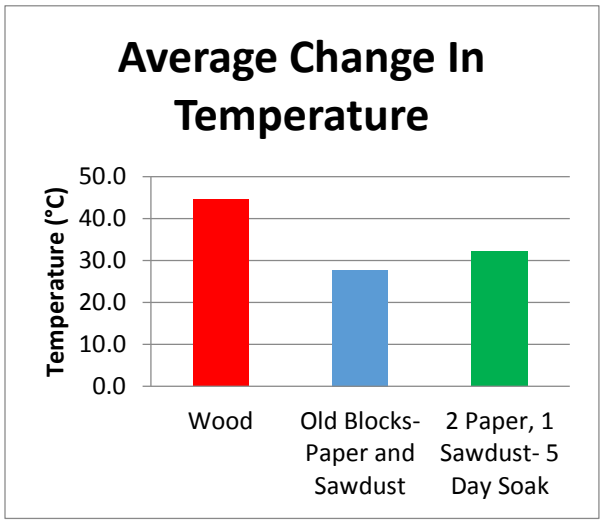

Figure 4: Average change in temperature of selected test samples

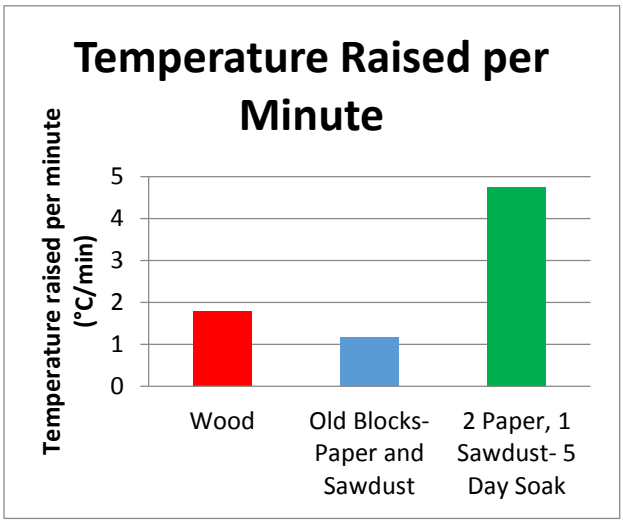

Figure 5: Temperature increase per minute of selected test samples

Once we developed a better paper block, it was important for us to develop a new business model so that the product could be successfully marketed and sold within the informal settlements. In order to do this, we needed to understand how successful businesses work in the informal settlements of Katutura. We spoke with 12 businesses located throughout the communities and were able to identify three business owners who expressed interest in being potential retailers of the paper block. These businesses gave us useful advice about everything from distribution to advertising, which helped us to develop a business model of our own. Our primary scenario involves MSR members manufacturing the paper blocks at the MSR offices where retailers with established businesses may purchase them for later resale.

Over the course of our project, it was important for us to involve MSR members in order for it to be successful in the future. To do this we worked with several MSR members and showed them how to make the paper blocks. We also held a meeting with 18 MSR members to introduce them to the project and receive their feedback. At the meeting we explained the production, distribution and sales models we developed and tried to answer any questions that they had. We were able to generate interest from the members and had eight people sign up for

future production. We also organized a larger scale demonstration where we showed MSR members how to make the blocks.

We developed a series of recommendations to help ensure the success of the Paper Block Project in the future. Our key recommendations are summarized below.

We recommend that MSR continues to develop and test new compositions for the paper block. While we were able to make great improvements to the performance of the paper block, there is always potential for further improvement. Further testing is needed to develop and identify the optimal composition of the paper block through addition of binding agents, to ensure that the block will be practical to transport and use.

We recommend that MSR actively market the paper block within the communities. In order for the project to really take off, MSR must proactively promote the block whenever possible. Some examples could include developing a name for the block, running a radio advertisement about the block, and holding community meetings in the informal settlements. Additionally, MSR should promote the project at all member functions including training sessions and MSR community meetings. By developing an improved paper block and a practical business model for the Paper Block Project, we hope to kick start the project, and ultimately enable MSR to create an income-generating activity for its members through the production and sale of this product, which provides an environmentally friendly alternative to firewood for residents of Katutura.

1 Introduction

Namibia is the most arid country in sub-Saharan Africa with the majority of its land considered desert or semi-desert. Only 3% of the country is considered sub-humid land with moderately good agricultural potential ("United Nations Millennium Project 2015 ", 2005). Due to low rainfall, drought is a common occurrence making Namibia more prone to desertification, which is the degradation of dry and arid land (Sweet & Burke, 2006). Human activities also contribute to and accelerate desertification in Namibia. Population growth in the last few decades, which has necessitated new housing and increased agriculture, has accelerated land degradation.

Due to high rates of rural unemployment, the rural poor migrate to urban areas to search for jobs. The vast majority of rural migrants move to the informal settlements of the capital, which are in Havana, Ombili, Okuryangava, Okahandja Park, and Hakahana. Most areas do not have legal access to basic services, such as electricity and running water (Fjeldstad & Geisler, 2005). In 2011, the population of the informal settlements grew by 10%, which amounts to about 10,000 Namibians (Graig, 2011). With few marketable skills, a saturated job market, and costly vocational job training programs, many remain unemployed in the cities.

Due to unemployment and the lack of access to electricity for electric stoves, people living in informal settlements are left to use wood as their primary source of cooking fuel (Palmer & MacGregor, 2009). A substantial number of people in the informal settlements make use of wood from dead trees to meet their cooking needs and supplement this with pallet wood. For many residents of the informal settlements in Katutura, wood is becoming harder to find and much more expensive. The overuse of wood will eventually lead to shortages and more serious environmental impacts, such as desertification, particularly if the flow of migrants to the informal settlements continues (Palmer & MacGregor, 2009).

To address this joint problem of environmental degradation and unemployment, our sponsor, Men on the Side of the Road (MSR), began work in 2011 to develop a feasible alternative for firewood. Under a grant from the United Nations Development Programme (UNDP), MSR has developed a sustainable alternative to firewood made from recycled paper and sawdust. In 2012, MSR hired a firm to conduct an evaluation to identify the communities' attitudes towards the paper block. The evaluation concluded that the block was not performing at

a level to adequately market it as an alternative to firewood within the informal settlements. This evaluation provided a starting point for our research, but more in depth feedback from a wider cross-section of people was necessary to develop a better design for the paper block and a plan to effectively market it in Katutura.

Our goal was to understand community attitudes towards the paper block, develop an improved design for the block, and collaborate with MSR members to develop a business plan. We conducted comparison studies between the paper block and current domestic fuels to determine if the current design meets the needs of the consumers. We also consulted with residents of the community, local entrepreneurs, and MSR members to create feasible business models that can be implemented by MSR members and other entrepreneurial-minded members of the informal settlements.

Chapter 2 offers a background to our project. In Chapter 3 we discuss the methods we used to reach our objectives. We detail our findings about the way people cook, the improvements we made to the block design and composition, and the way information travels through the informal settlements in Chapter 4.

2 Background

Historically, black people in Namibia have been segregated and discriminated against, inhibiting them from competing for nearly all jobs in the formal sector. The black population had been forced to live in informal settlements during Apartheid, where basic services such as electricity and water were not delivered. Although some settlements have formalized, the lack of services continues to be a problem in many informal settlements today. Due to the lack of electricity and insufficient funds to buy kerosene, known locally as paraffin, many residents of the informal settlements continue to use wood as a domestic fuel because it is less expensive. The collection of firewood across the region in combination with the arid climate of Namibia has resulted in extensive desertification in the country. Desertification is defined as "land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (*United Nations Conference on Environment and Development*, 1992). It results in soil depletion and diminished growth of vegetation. Several organizations have arisen to help lessen environmental degradation in Namibia, combat unemployment, and improve living conditions of residents in informal settlements. Men on the Side of the Road (MSR), based in Katutura, in the northwest region of Windhoek (Figure 6), is one such organization. One way in which MSR has worked to accomplish these goals is through the creation of a product made of waste paper and sawdust that can be used as a substitute for firewood.

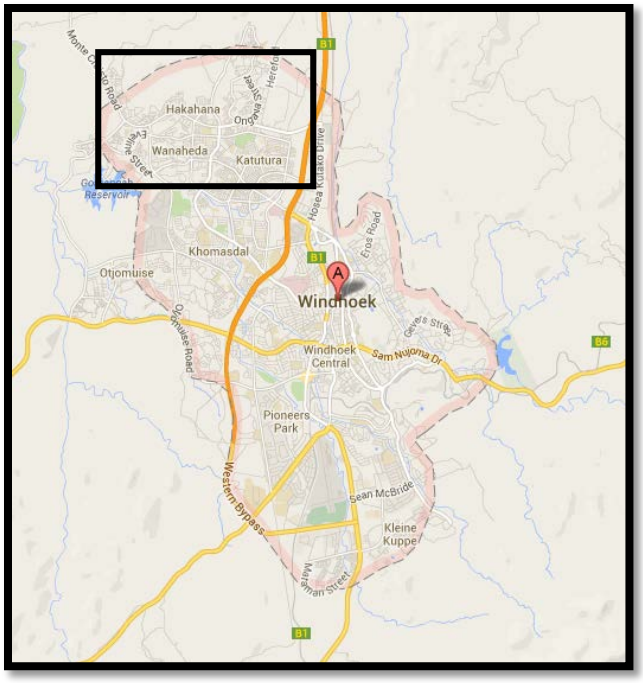

Figure 6: Map of Windhoek detailing the location of Katutura and its surrounding neighborhoods ("Windhoek - Google Maps," 2014)

2.1 Job market outlook in Namibia

Namibia has one of the highest unemployment rates in the world. It is important to note that the term unemployment can take on many different meanings and be discussed in a variety of ways. For our purposes, unemployment will refer to the broad definition, which includes all people who currently do not have work and yet have the capacity to work (Steytler, 2013). This definition is illustrated in Figure 7 below, taken from the 2012 Namibian Labour Force Survey (NLFS) conducted by the Namibia Statistics Agency (NSA).

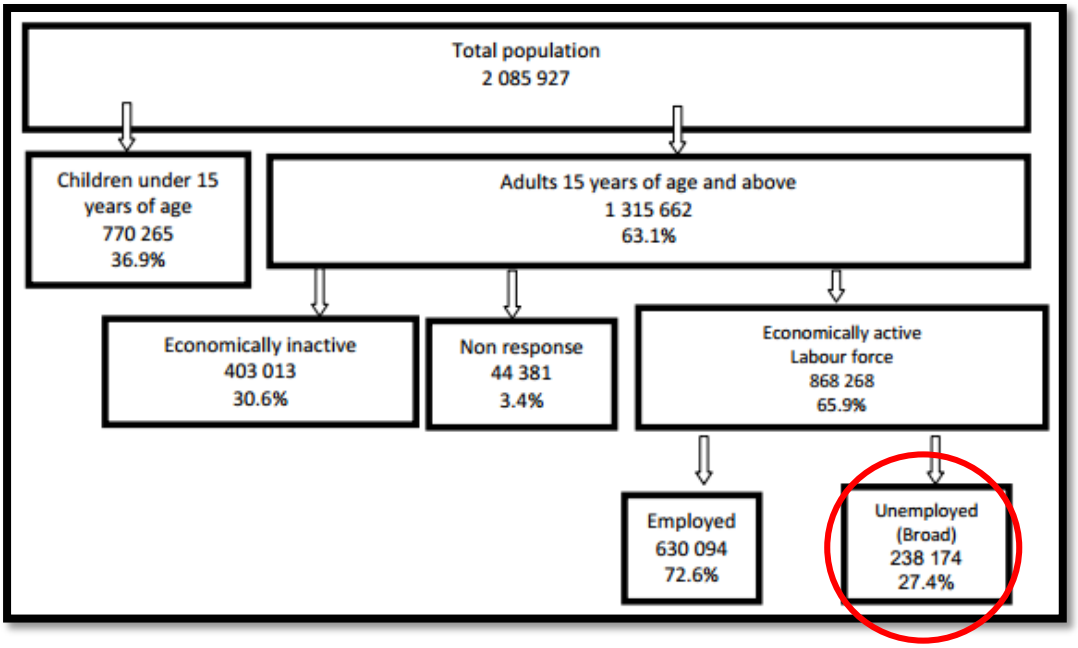

Figure 7: Population Activity Status (Steytler, 2013)

The economically inactive population that incorporates over 30% of the population shown in this figure includes a variety of people that, for different reasons, are unable to work. This includes full time students, homemakers, apprentices, the sick and disabled, as well as individuals who retire early. Those that are employed consist of all economically active people who have worked for a specified amount of time per week, receiving payment for their efforts, profit from a business, or family gain (Steytler, 2013).

2.1.1 Unemployment and Underemployment

In the 2012 NLFS, the unemployment rate in Namibia was determined to be 27.4% of the population. The survey's unemployment statistics were based on a series of questions that counted a person as employed for a wide range of activities and jobs performed for the benefit of the household. Some of those jobs involve gathering firewood, farming, collecting water, or working in family business's without any pay (Steytler, 2013). The 2012 NSA report aimed to give a closer and more accurate representation of the unemployment levels in Namibia than in years previous. The new questions give the NSA more possibilities to understand the industries in which people are employed, get a better sense of the economic situation within the country, and identify how many people are unemployed and why. The state of the economy remains

largely unchanged over the past decade even though the unemployment rate has appeared to decrease.

The industries that employ the largest number of Namibian citizens are the agriculture, forestry, and fishing industries, followed by wholesale and retail trade, and private households which combined, account for almost half of the employed population (Steytler, 2013). Women will generally gravitate towards working in private households due to the fact that they are traditionally seen as the caretakers of their own households in Namibia. Women are the ones who do most of the cleaning, cooking, shopping, and other household tasks (Steytler, 2013). Men tend to gravitate towards the industries that require more manual labor. Many of the construction and manual labor jobs that men acquire are from going to the sides of roads in certain designated spots on the edges of the city and waiting to find work as day laborers. People are aware of these places that the men will wait, and pick them up to hire them for the duration of the project or for a day. Most of the men who find success in this job market have experience and previous relationships with employers that give them an upper hand. Those workers without these relationships are left with an unsteady and insufficient income (Steytler, 2013).

Although many of the men who are defined as day laborers are considered employed, they fall into the specific subsection that is known as underemployment along with many other individuals. Underemployment refers to situations in which workers do not make the amount of money that they are capable of making and need in order to adequately provide for themselves and their family. Currently, the rate of underemployed workers within the employed population of Namibia is 15% (Steytler, 2013). The majority of underemployment cases result from workers not having the chance to work enough hours over the course of a week due to an over saturation of workers within the job market.

Unemployment and underemployment in Namibia are some of the biggest social challenges the country faces today. For the people who are looking for work or looking to supplement their current work, every day can be a struggle.

2.1.2 State of the Economy

The average annual income of a Namibian is about 68,878 Namibian dollars (N$), which is the equivalent of less than $6,500 in the United States. However, over half the country does not earn the minimum amount of money needed to live a low income suburban lifestyle in

Namibia, which, according to the 2010 Namibian Household Income and Expenditure Survey (NHIES) conducted by the NSA, has been estimated to be about N$17,800 annually. Therefore the average annual income is not a good representation of the population because of the number of affluent families residing in Namibia. According to this report, 20% of Namibian households fall below the poverty line as shown in Figure 8 (Steytler, 2012; "Tick-Tock, Tick-Tock," 2014).

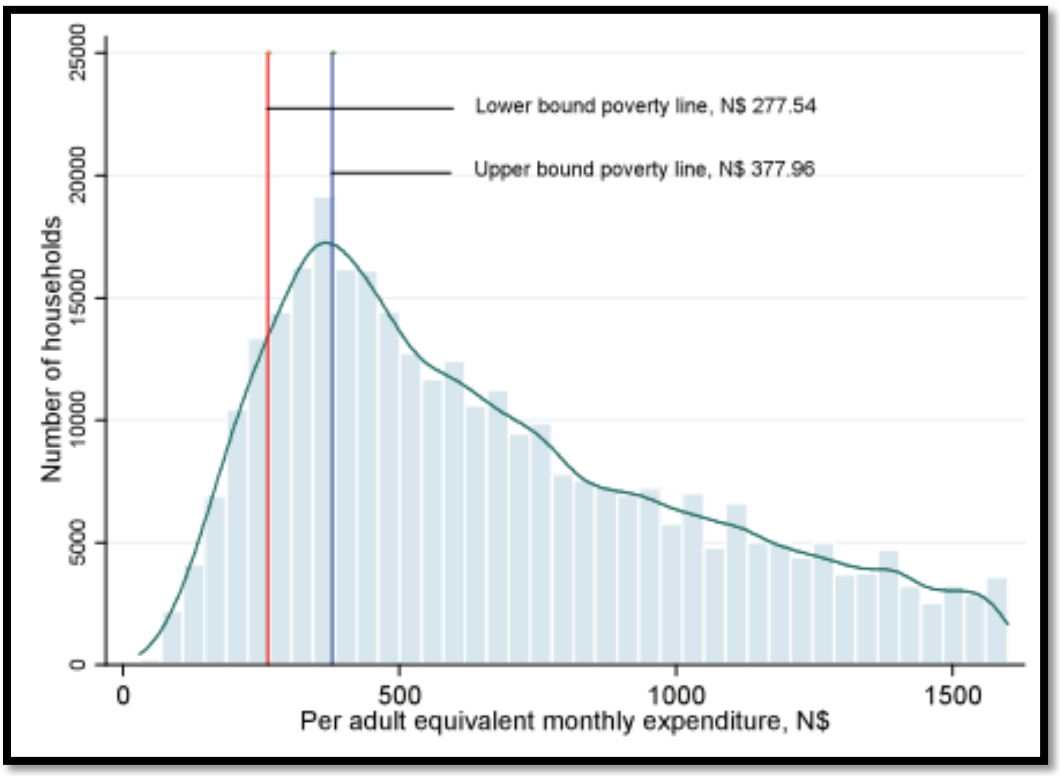

Figure 8: Households Monthly Expenditure across Namibia (Steytler, 2012)

A distribution of the nation's households in relation to the expenditure levels of the houses is displayed in Figure 8. The upper bound poverty line is used to determine whether or not a household is considered in poverty, and the lower bound poverty line is used to determine whether or not a household is in extreme poverty (Muteyauli, 2012; Steytler, 2012). In statistics, a normal distribution here would indicate a healthy economy, but this graph is known to be "skewed right". The severity of this skew shows that a large number of households fall beneath the average income line, indicating a severe wealth disparity between the high and low income households in Namibia.

2.2 Urban Migration

Urban migration is the label given to the influx of people from rural areas to the cities. The people come for many different reasons, and some will stay, but the majority of them view this as only a temporary journey, and maintain connections to family and friends in the places they left (Frayne, 2004).

2.2.1 Push and Pull Factors

When discussing urban migration it is almost impossible not to come across the terms push and pull factors. One push factor, or driving force spurring people to migrate, in Namibia is the extreme poverty and unemployment in rural areas. Most people will require a desperate situation to leave their homes and the life that they have known. It is estimated that 75% of all the Namibians living in extreme poverty are located in rural areas where people try to live off of subsistence farming (Purdy, 2006). This is not the same as simply saying that 75% of rural residents are extremely poor. According to the 2010 NHIES, 27% of households in rural areas are classified as poor with 14% falling into the severely poor category. For people living in these areas who are poor and find themselves without many options, migrating may be something they view as an opportunity and a necessity.

In rural areas, many people rely on agriculture to make a living. These farmers' and ranchers' livelihoods are always susceptible to the weather and environmental impacts. Over the past two years, Namibia has faced a severe drought. In late March 2014, the weather changed and many of the farmlands were faced with extreme flooding ("Namibia: Floods," 2013; Tjihenuna, 2014). Both circumstances made it hard for farmers to grow crops or raise livestock (Fisher, 2013). Many of the people who have trouble overcoming these difficulties try to find job opportunities elsewhere.

When pushed out of their homes, rural populations will, for the most part, try to move to other rural areas where they would be working similar jobs that required much of the same skills they already possessed making the transition easier. However, there is still a significant amount of migration from rural to urban areas (Frayne, 2004). According to the NHIES unemployment in the cities is 29.7% compared to 37.7% in the countryside. Because of these relatively better chances of employment in the cities, many people are drawn to them.

Cities in Namibia, Windhoek in particular, have grown at a brisk pace. Between 2001 and 2011, 10% of the population of Namibia moved to an urban environment, which by the 2011 census was approximately 211,000 people (Kafidi, 2011). The influx of people to the cities has added to stressors on the cities' governments, resources, and has strained the job market. Many of the people coming to the city may be left disappointed by their experiences trying to find a job. As a result, the majority of migrants are unable to afford housing in the city and have been left to live in the informal settlements.

2.3 Informal Settlements

Informal settlements, or groups of unregistered homes, exist in many places around the globe. The people and houses that make up informal settlements are incredibly diverse. These settlements tend to develop where there is poverty and a shortage of housing. Around Windhoek, the houses are typically self-constructed with wooden frames and siding made from corrugated metal sheets, materials that can be found cheaply, or for free (Muller & Mbanga, 2012). A typical shack, locally known as a kambashu, can be seen below in Figure 9.

Figure 9: Typical Kambashus in Katutura

Katutura, an area with large informal settlements in Windhoek, was initially organized in the 1950's as part of Apartheid (Pendleton, 1996). Apartheid was the government policy of segregating people of different races. During the German occupation of South-West Africa (now Namibia) during the late 19th and early 20th centuries, the natives were pushed off their land and forced to live in separate areas called locations (Pendleton, 1996). After the Germans lost World War I, the colony that would eventually become known as Namibia was given to the British and placed under South African rule. The new rulers quickly implemented the system of Apartheid

(Pendleton, 1996). With the system of Apartheid came the development of a location to the northwest of Windhoek named Katutura which translated from the local language of Otjiherero means ‘place we do not want to live.’

2.3.1 Apartheid History

Apartheid is the institutionalized process of segregation by race. The major tools of Apartheid included The Group Areas Act, which limited where people of different racial groups were allowed to live; The Bantu Education Act, which restricted access to education; and the pass laws which dictated people’s mobility (Pendleton, 1996). These laws collectively favored the rights of the occupying white people over that of the natives and other colored people. However, even white people required passes to travel and visit areas that were designated for the non-white populations (Pendleton, 1996).

The Apartheid system was implemented and enforced even more effectively in Namibia than it had been in South Africa (Pendleton, 1996). The population of Namibia was much smaller than that of South Africa, so it was easier for the government to enforce the laws. In addition, the areas designated for the non-white populations to live in were spread out further around the cities, making it much harder for people to sneak around the pass laws (Pendleton, 1996).

When the white population grew larger, South African administration needed more space and decided to create the location of Katutura in 1959 (Pendleton, 1996). Katutura was, at the time, further away from the main city, and the government was able to rent out plots of land for people to live on (Pendleton, 1996). While Katutura and the other townships were initially government controlled zones, over time they have grown at a pace that has outstripped government expectations and plans, but due to the history of settlement removal and government ownership, there is a long period of hesitancy by residents to invest in the neighborhoods.

2.3.2 Government Stance on Informal Settlement

Under the control of the South African government, black people were viewed as second class citizens in comparison to the white population and were therefore not eligible for government assistance when setting up their homes (Wilson, 2001). As a result, the informal settlements set up by the Apartheid laws, including those in Katutura, lacked any sort of municipal services (Mitlin & Muller, 2004). After Namibia gained independence from South

Africa in 1990 and Apartheid ended, the government prioritized the needs of the informal settlements by providing more essential municipal services ("Build Together: The National Housing Programme (Namibia)," 2014).

In the ten years following independence, the city government of Windhoek provided over 6,000 utility serviced blocks to its communities (Mitlin & Muller, 2004). This government assistance encouraged the unemployed in Namibia to come to Windhoek and construct permanent residences. However, there are still major strides to be made in the development in the informal settlements. Even in 2013, the Windhoek mayor's office acknowledged that significant parts of the informal settlements are still lacking basic municipal services, including running water and electricity and that nationwide, over one million people lack formal sanitation (*Mayoral Report 2013*, 2014; Tjihenuna, 2014). Overall, the government is improving the resources for new migrants to Windhoek, while trying to eliminate racial stigma left by Apartheid. It is important to understand this history to realize the imposed limitations that the black population has been living under and still work to break out of, including limited educational opportunities and skills acquisition.

2.4 Life in Informal Settlements

In Katutura, most basic services are not provided (Fjeldstad & Geisler, 2005). Many residents do not have access to individual water taps so they have to walk to communal taps to get water every day. Due to the scarcity of water, sanitation has also become a major issue in the informal settlements where toilets are uncommon for public use ("2006-07 Namibia Demographic and Health Survey," 2008). Additionally, a significant number of residents in these shanty towns do not have access to electricity. The energy deficiency makes them rely heavily on fuels such as wood and paraffin for cooking (United Nations Human Settlements, 2005). Although paraffin is an effective fuel, it is a dangerous form of light and heat. A paraffin lamp or stove similar to the one seen in Figure 10 below can tip over in a shack and start a fire, which spreads quickly and causes damage to the homes of many informal settlers. In the communities of Katutura, shack fires are a serious concern. This risk is especially prevalent during the winter due to the increased need for heating at night ("2009 World Disasters Report," 2010).

Figure 10: Paraffin stove typical of those used in the informal settlements

In addition, the use of firewood adversely affects the lives of many inhabitants in the informal settlements. Traditionally, Namibian women perform the majority of household and agricultural labor tasks. Some women travel almost daily to the forests to collect wood for cooking (Palmer & MacGregor, 2009). As the population grows, more fields are cleared for crops and housing resulting in further shortage of firewood. Nowadays, women have to walk several kilometers and spend numerous hours to find wood for preparation of food (Hunter et al., 1990). Collecting wood is a not only time consuming, but is also a dangerous process. The woods are habitat to dangerous animals such as venomous snakes (Martha Amupolo, personal communication, March 20, 2014). Furthermore, transportation and combustion of wood can lead to certain health conditions such as back problems, severe fatigue, and respiratory infections (Rehfuess, Mehta, & Prüss-Üstün, 2005). When a household does not have time to collect wood, they have to purchase wood from local vendors. These entrepreneurs, usually with vehicles at their disposal, tend to overprice the firewood (Palmer & MacGregor, 2009). Firewood as a domestic fuel has become a more expensive fuel choice for households in the informal settlements over recent years.

2.5 Desertification

As the population has expanded, the demand for firewood has also increased and led to many environmental issues. The over-consumption of this resource results in widespread

deforestation, soil erosion, reduction of the local water cycle, loss of habitats for many native species, and, more seriously, desertification (World Bank et al. 2009).

Desertification has been acknowledged as one of the greatest challenges not only in Namibia but also in large parts of the African continent (Kreike, 2009). Lack of rainfall is believed to be the most important cause of desertification in Namibia. With the majority of the land considered semi-arid or arid, Namibia is the driest country in sub-Saharan Africa. The average annual rainfall is around 270 millimeters (mm). As a comparison, the average annual rainfall in Worcester, Massachusetts is 1220 mm ("1981-2010 Climate Normals," 2011). The amount of rainfall in Namibia is insufficient to support the agricultural production and forest regeneration from desertification (Sweet & Burke, 2006). In fact, only 5% of the country receives more than 500 mm of rainfall a year, the minimum threshold to avoid classification as arid land (Sweet & Burke, 2006). Furthermore, the rate of evapotranspiration, which is the movement of water to the atmosphere from plants and the ground, is oftentimes higher than the precipitation; hence drought is a common condition throughout the country (Heyns, 1991).

Although lack of rainfall is the primary cause of desertification, human activities in Namibia also have serious impacts on the country's environmental changes. Arable land in the country is limited and can barely support the population of 2.1 million people, two million livestock, and the current amount of agricultural activities (Work Bank et al., 2009). The large numbers of livestock overgraze the vegetation cover that protects soil from erosion. Furthermore, due to the lack of electricity in informal settlements and rural areas, and the dependence on wood for domestic purposes, forests are over-exploited, and soil nutrients are significantly reduced when wood decomposition is cut out of the nutrient cycles when, for example fallen branches are stripped from the landscape (Coleman, Crossley, & Hendrix, 2004). If no effective intervention is applied, Namibia could face lower supplies of water and higher rates of extreme drought (Lemenih and Bongers, 2011).

Proper land-use practices can significantly reduce the rate of desertification in Namibia (Ward, Ngairorue et al., 1998). Many organizations have launched environmental protection programs to promote the conservation of forests and woody vegetation. The outcome of these preservation initiatives will influence the future of Namibian environment resources and communities.

2.6 Alternative Fuel Source Projects

One way to attempt to combat the aforementioned social and environmental issues is through the use of sustainable firewood alternatives. These range from compressing and reusing charcoal dust to combining plant husks and leaves to use as fuel sources. There are several organizations and companies working to create and bring to market viable firewood supplements and substitutes around the globe. One of the largest and most successful of these is Chardust based in Nairobi, Kenya. Chardust re-presses the dust left over from burning charcoal and adds a binder to make their briquettes ("The Chardust Project," 2014). They have successfully manufactured and sold briquettes since 2000. Currently they sell more than seven metric tons of recycled briquettes, similar to those seen in Figure 11, a day.

Figure 11: Chardust drying racks for briquettes (chardust.com)

Additionally, the Harvest Fuel Initiative is a partnership between the Massachusetts Institute of Technology (MIT) and the Charcoal Project. They work on a global scale but tend to focus primarily on the South Pacific region. They have set up an informational forum to discuss tips and tricks for manufacturing briquettes out of materials ranging from corn husks to dried leaves and charcoal dust. They also have some discussions about creating a business after developing the briquettes ("The Charcoal Project," 2013; "The Harvest Fuel Initiative," 2014). While these projects are all aimed to provide an effective and useful resource, the majority result in micro scaled enterprises that have struggled to compete and face challenges as permanent, sustainable businesses.

Finally, the Namib Desert Environmental Education Trust (NaDEET) is a nongovernmental organization based in Swakopmund, Namibia. NaDEET focuses on teaching

students who visit about the environment, specifically in regards to the Namib Desert. They educate their students to reduce waste and combat desertification by teaching them to make their own recycled paper firebricks ("Namib Dessert Environmental Education Trust," 2014). The only aim of the project is to have people make the firebricks for their own personal use rather than start businesses of their own.

While all of these efforts have resulted in viable alternative domestic fuels, none of them have provided sustainable forms of employment for local community members. Men on the Side of the Road hopes that as a result of our project improvements, there will be sustainable jobs for members of the community to manufacture and sell the paper blocks in their community.

2.7 Men on the Side of the Road and the Paper Block Project

In 2001, MSR was founded as a non-profit organization in South Africa. Their goal is to combat unemployment by linking unemployed citizens with work and training opportunities. In 2007, MSR expanded to Namibia where they work in collaboration with the local government, organizations, and individuals to facilitate training workshops for its members. These trainings are meant to cover a wide variety of skills ranging from truck driving to small engine maintenance and repair ("MSR home," 2014). This allows MSR to connect its members with employment opportunities by creating an environment for interaction between the general public and the job seeker at established MSR points. Since its foundation, MSR has successfully conducted work placement for approximately 200 people each year ("MSR home," 2014).

In 2011, under a 2010 grant from the United Nations Development Programme (UNDP), MSR worked with local businesses to develop an alternative to firewood that could be manufactured from waste products already gathered around the city (Villar et al., 2012). The block itself is made of a mixture of paper, sawdust, and water. By collecting waste office paper from Rent-A-Drum, a waste management organization in Windhoek, and sawdust from the Windhoek Vocational Training Center, MSR members are able to produce the paper block with almost no cost for materials. While the block was successfully created, there was substantial resistance to adopting the block as an alternative fuel (Schenck, 2012).

When the block was first developed, MSR attempted to market the blocks to the population of Katutura. They produced leaflets that showed the benefits of the blocks when

compared to paraffin or firewood as well as employed a third party to create a report of recommendations for future work (Schenck, 2012).

The previous evaluation recommends focusing on proving the viability of the paper blocks as an alternative domestic fuel for the population of Katutura. However, there are some major shortcomings of the previous evaluation. Most notably, the opinions of just eight MSR members and employees were represented in the findings and recommendations developed by the consultant (Janet Wicks, personal communication, February 18, 2014). In addition, the report makes no mention of the methods used to acquire the information used in the evaluation. These inconsistencies provided opportunities for our own project to address in our time in Namibia.

Our project builds on the recommendations made by the previous evaluation. We assisted MSR in their efforts to raise awareness about the paper block in the community. We also worked to improve the quality of the blocks so that they can be used as an alternative to firewood. As a result, we hope to lessen the effects of desertification as well as provide employment to local residents who can manufacture or sell the blocks. The next chapter explains the methods we used to accomplish our objectives.

3 Methods

The goal of this project was to work with Men on the Side of the Road (MSR) to understand the Katutura community's view towards a firewood alternative paper block, to improve the block's performance, and develop a new business model to manufacture and distribute the blocks within the communities. Accomplishing these goals will not only create more job opportunities in the community through micro-entrepreneurships, but also slow desertification in Namibia. We developed the following objectives in order to achieve these goals:

1. Gain an understanding of current cooking methods in Katutura
2. Understand how the paper blocks compete against other cooking fuels with respect to cost, performance, convenience, suitability, and safety
3. Identify the current perception of and potential demand for the paper block by the general public
4. Identify the product quality and propose an improved design for the paper block
5. Understand how local residents share information through social networks, specifically from the perspective of small enterprises in Katutura
6. Assess and identify the strengths and weaknesses of the past marketing plan for the paper blocks
7. Develop a new marketing plan and sales model for the paper block
8. Train and empower local individuals to continue the project in the future.

In this chapter, we discuss the methodologies we used to complete each objective, and why each method was chosen.

3.1 Objectives

1. Gain an understanding of current cooking methods in Katutura

The first step of this project was to develop an understanding of the current methods the residents of Katutura use to cook their meals. To do that, our team visited different communities in Katutura and talked to local residents about their cooking practices. Tessa Olavi, an intern at MSR, and John Apopya, an MSR member, aided us during our visits with community members.

They translated our questions to Oshiwambo whenever necessary since the majority of community members are not as comfortable speaking in English. During the first three weeks of our project, we visited the communities as a group with Tessa; later, John joined our team and we were able to split into two groups with the help of the two translators. We conducted interviews with 25 local residents, primarily women, in four different communities of Katutura: Havana, Okuryangava, Omlibi, and Okahandja Park, to obtain this knowledge. According to Tessa, who lives in Katutura, most people in Havana do not legally have access to electricity and are therefore are more reliant on firewood than people in other communities. We thus decided to focus our work in Havana, and talked to 13 residents of Havana to obtain an understanding of how people cook in the community. Since it was important for our team to establish a connection with local residents, we started the interviews with some general questions about their daily life, specifically the activity that they were doing when we arrived. For example, we arrived at one woman's home where we saw a large pot of oil cooking over an open wood fire, so we asked her what food she was making and asked her to tell us more about the food. By doing that, we were able to show the settlers our interest in their life, get to know a little about them, and to open the interview on a lighter note in hopes that they would be more willing to help us in our studies.

After the initial introductions, we asked the residents about the fuel types they use, where and how they get their fuel, as well as how much the fuel costs. We asked about how often and when they cook. We were also interested in finding if there were any social tensions around wood gathering and provision. Refer to Appendix A for the complete set of interview questions. We observed and documented the techniques people used to cook their meals through the use of written notes and photographs for future reference. This information was essential for us to put our project in an appropriate context.

2. Understand how the paper blocks compete against other cooking fuels with respect to cost, performance, convenience, suitability, and safety

The next step of our project was to develop a profile of other cooking fuels available in Katutura with respect to cost, convenience and suitability as well as health and safety risks to understand how the paper blocks compete against them. For the paper block to be successful in the marketplace, it must either be cheaper, more convenient, or more suitable for cooking food than other fuel sources available. We asked community members how much they spend on their

current cooking fuels every day and how accessible the fuels are as well as the fuels' suitability for the meals they make. A list of questions we used to achieve this objective can be found in Appendix A.

3. Identify the current perception of and potential demand for the paper block by the general public

Once we had a general understanding of different characteristics of other cooking fuels available in Katutura, we identified the current perception of local residents toward the paper block. It was critical to develop a sense of community input to the project, as well as to identify any problems that may exist with the paper block. MSR helped us identify three families to pilot test the paper block. One of them was an MSR member and the other two were neighbors of MSR members. In order to increase the credibility of our work, we identified another four families on our own to expand the interview sample. We identified these four families by looking for people who were cooking while we traveled through the informal settlements. At the end of our interviews with community members about their cooking practices, we gave those who were interested ten to fifteen blocks with varying compositions and then revisited them after a week to obtain their feedback on the performance of the blocks.

Since the pilot families had firsthand experience, they were able to give us valuable insight into the performance of the block. We gathered additional opinions from people who happened to stop and ask about the blocks as they passed by. Many of them were neighbors of the resident who came over because they were curious about our presence in the community and the blocks we brought. Thus our interview originally started with a local individual, but usually turned into a group discussion with up to five or six individuals at the end. This type of sampling is called convenience sampling in which a sample population is selected because it is readily available and convenient, as researchers are drawing on relationships or networks to which they have easy access (Wint, 1997).

While we were interviewing these community members, we faced numerous challenges. The interviews generally took between an hour and an hour and a half depending on the number of people who participated. However, we occasionally had some difficulty keeping the residents focused on the topic of our interest. Since we did not understand the local language and had to wait for Tessa or John to translate, it was challenging to keep track of the conversations. In

addition, the majority of our interviews took place outside of the residents' house where we found them cooking a meal. Combining the heat from the strong sun with the translation issues and the occasional large group of people made it more difficult to effectively facilitate these meetings.

During the interviews, we asked the pilot families about their experience with the paper blocks. The reactions of the people encountering the paper block for the first time were valuable to our research because they gave us a sense of what to expect if we introduced the block to the market. We were interested in understanding the techniques people used to cook with the blocks. We asked them what they liked and disliked about the cooking qualities of the blocks as well as their opinions on how we could improve the block's performance. Refer to Appendix B for a full list of questions used in these interviews.

4. Identify the product quality and propose an improved design for the paper block

Moving forward, it was necessary to evaluate the current product quality to address some of the concerns of the pilot families. We conducted a comparative study between different types of blocks and firewood. Before coming to Namibia, we met with Professor Nicholas Dembsey in the Fire Protection Engineering (FPE) department at Worcester Polytechnic Institute (WPI). He informed us that the best test to perform would be a comparison test where different fuels are used to boil one liter of water and the differences in performance are observed. Our initial tests were qualitative with three types of blocks with different compositions in a fuel-efficient stove and in open air. The stove was made from recycled materials and built by Tomas Shilongo, an employee of MSR. The testing setup can be seen in Figure 12 below.

Figure 12: Testing setup for open air and stove based burn tests

The three types of blocks were plain office paper, office paper mixed with sawdust, and newspaper mixed with sawdust. We observed three parameters: the time taken to ignite, the time taken to burn one block to ashes, and the smoke produced by the block. Each block was broken into three roughly equal pieces as seen in Figure 12 and set alight. The time taken to ignite was measured from the moment the match hit the newspaper kindling to the time one part of the block caught on fire. The time taken to burn one block to ashes was measured from the time the block ignited to the time the block extinguished itself as determined by the project team. The smoke produced was a qualitative measurement as determined by the project team.

After conducting research into similar products, talking to the community, and conducting our own tests, we developed several new physical designs that would allow the block to burn better and require less tending by the user.

After a new design had been developed, it became important to understand what mixture of materials within the blocks produced the best flame with the new design. In order to do this, we set out a variety of soaking buckets with varying amounts of paper and sawdust. We also set out mixtures with the same ratios of materials, and varied the amount of soaking time that they received. Because the blocks are made of simply paper and sawdust, we explored the possibility of re-soaking the old blocks and molding them into the new shape. After each batch of blocks was left to soak and dry completely, we performed quantitative tests to determine the heat transfer rates and properties of all the new blocks, as well as the old blocks, and wood.

We began testing the paper blocks by placing three stone bricks in a circle large enough to support a pot while the lengthwise span of the blocks faced the center. We put another three bricks on top of the first three so that the top of the bricks was high enough to allow fuel to be placed underneath. We crumpled up four small pieces of newspaper equaling the size of one page (half of the unfolded sheet) and place them in the middle of the bricks. We took a paper block and broke it into three pieces and placed them in a triangular pyramid shape between the bricks and on top of the newspaper. This setup can be seen in Figure 13.

Figure 13: Setup resembling traditional cooking method used for quantitative testing

The pot was placed over the stone bricks and fuel. We then filled the one liter container with water and poured it into the pot. The amount of water used must be consistent in order for the tests to be uniform and enable us to compare the results. We took an initial measurement of the temperature of the water on the inside of the pot before each and every test. Matches were used to light the newspaper underneath the paper blocks and the timer was started. Every minute, the temperature of the water on the inside of the pot was recorded. We used a CEN-TECH Non-Contact Infrared Thermometer to safely and accurately measure the testing temperatures from a distance. For full product specifications see Appendix C.

We tended to the fire by knocking ashes off of it and fanning it in order to revive the fire whenever it died out before the paper blocks were done burning. We recorded the time that the paper blocks stopped burning and the temperature of the coals at the conclusion.

The data collected during our own quantitative studies on the paper blocks was then analyzed with Microsoft Excel. The setup of our data chart is shown in Figure 14. This data analysis allowed us to compare the paper blocks to firewood in order to identify the qualities of the blocks as well as determine the best composition of the paper blocks.

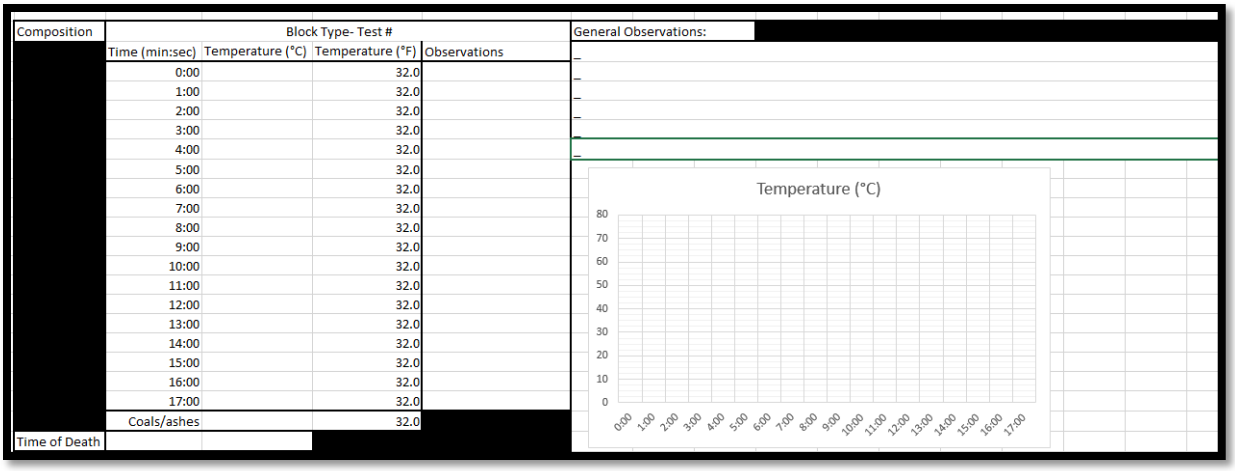

Figure 14: Spreadsheet used to analyze quantitative test data

5. Understand how local residents share information through social networks, specifically from the perspective of small enterprises in Katutura

In order to market the paper blocks, we needed to understand how information is disseminated in the communities. There were two critical perspectives that we needed to observe in order to have a good idea of how businesses advertise in Katutura: the current practices of local businesses and the reaction of local residents to advertising.

In order to determine how local businesses advertise products, we interviewed business owners in the main open markets as well as those in other places throughout the communities. We asked businesses owners about the methods they used to let people know about their shops and which methods worked best. A full list of questions can be seen in Appendix D.

To grasp the views of the general public toward advertising, we conducted interviews with local residents. During our interviews, we asked local residents how people learned about new products as well as what suggestions they had to help us advertise the paper block. This input from the community was valuable because they have a deeper understanding of the day-to-day interactions of people in the community than we do. The list of questions can be seen in Appendix E.

6. Assess and identify the strengths and weaknesses of the past marketing plan for the paper blocks

After gaining a general understanding of how advertising is done in the informal settlements, we evaluated MSR's past advertising strategy for the paper block. We analyzed the data collected from our interviews with Katutura residents to identify the strengths and weaknesses of the past advertising tactics.

We interviewed Hilya Kambanda and Tomas Shilongo, employees of MSR who have been involved with the Paper Block Project to gain an in depth understanding of how the advertising campaign was built and how it progressed. We asked Hilya and Tomas about the forms of advertising that MSR used to market the paper blocks. We also asked them to share their opinions on the outcomes of the past advertising plan, specifically why the project had yet to catch on. We also asked about how the members who manufactured the blocks were paid and how the products were distributed to the customers. Refer to Appendix F for a list of interview questions we asked the MSR employees. Besides the interviews with Hilya and Tomas, we also looked into was the Paper Block Project folder on the MSR file system that included all documents related to the project to find additional information about the business model for the project. We specifically looked for the wage an MSR member earned for every block they made and the numbers of blocks a member could produce in a day.

To further assess the past marketing plan, we contacted Pius Shambabi, an MSR member who worked as the project coordinator from 2012-2013, and interviewed him about his experience with the project. We met him at the Polytechnic of Namibia where he currently worked as an Information Technology Technician. We asked him about his tasks as a project coordinator as well as his opinions about the outcomes of the project. We also asked about his experiences selling the paper block, and his opinions about what methods would work best for raising community awareness about the block as well as what distribution methods he thought would work the best. Refer to Appendix G for a list of questions we asked at the interview.

7. Develop a new marketing plan and sales model for the paper block

For the new marketing plan to be successful, we created a list of approaches to address the limitations of the past sales methods and to tackle the barriers towards paper block use, so that the paper block could gain acceptance in the informal settlements. After we identified the

competitive characteristics of the block, we emphasized those features in the new marketing plan.

We also interviewed 12 businesses to gain an understanding of how businesses were run in Katutura. We asked about how they started their business and what sort of challenges they faced when they started their business. A full list of questions we asked can be found in Appendix D. At the end of the interviews, we introduced the paper blocks to them and asked if they were interested in selling the blocks from their business.

8. Train and empower local individuals to continue the project in the future.

As we successfully developed a better paper block and created a business plan, it was important for us to involve MSR members in the process of our work so that they could take the ownership of the project in the future. During our time in Namibia, we worked closely with John and Tessa. We asked them to come to the MSR office and help us make blocks three times. We discussed the new design and the reasons for making the changes that we did. We then demonstrated the techniques for making blocks with the new design and had them practice it. In addition, they participated in our testing process. We showed them the testing set up and the procedure, and explained to them the data we were trying to collect and why. By doing that, we were able to help John and Tessa understand every step of our work.

We also conducted an MSR member community meeting in order to gain feedback from members about our business model as well as gauge their interest in manufacturing and selling the paper block. We invited two women from the community to attend, one who had experience using blocks with the previous design and one who had used the new design. At the meeting, we explained the purpose of the project, the work we had done, and our findings and results. We described the business model we created to members and asked for their feedback. At the end, we led a discussion with the members focusing on their concerns and questions about the future of the project. Many members asked questions related to the production of the blocks specifically about the availability of materials and paper block presses. Some members asked the residents to share their experiences with the blocks. Members who were interested in making and selling the blocks left their contact information so we could contact them in the future.

Before we left, we organized a paper block making demonstration to show members how to make the blocks with the new design. John and Tessa helped us demonstrate the necessary

techniques. This demonstration allowed us to teach MSR members the skills they need to make the new blocks. We hope that MSR members will take ownership of the project and take the initiative required to earn a sustainable income from the Paper Block Project.

4 Findings and Results

After the first couple weeks of our project, we came to understand that the 2000 paper blocks previously made by MSR members were not suitable for cooking food. We were also confronted with the fact that there was little to no record about the Paper Block Project, including an established composition of the existing blocks. Additionally, we found that a majority of MSR members were not aware of the project and no residents of the informal settlements had heard of the paper block before. In this chapter, we describe how we learned about current cooking practices from local residents, understood people's perception of the paper blocks, and worked with residents of the community to develop a product that could better meet their needs. Through various methods of observation and experimentation, we developed a knowledge base that allowed us to effectively help MSR make better paper blocks and better understand potential production and marketing channels for the product as an alternative to firewood.

4.1 Initial Interactions with the Community

Katutura is located in the northwest of Windhoek and is composed of seven different informal settlements that are situated along Monte Christo Road, a main street that runs east and west through the region. The communities of Greenwell and Goreangab are south of the road, closer to the city. Havana, Hakahana, Ombili, Okahandja Park and Okuryangava are communities north of the road, closer to the outskirts of Katutura. A map of the seven communities can be seen in Figure 15. A view of The End of the Road, a taxi stop as well as an open market that is located at the end of the paved main road in Havana, is shown in Figure 16 and Figure 17.

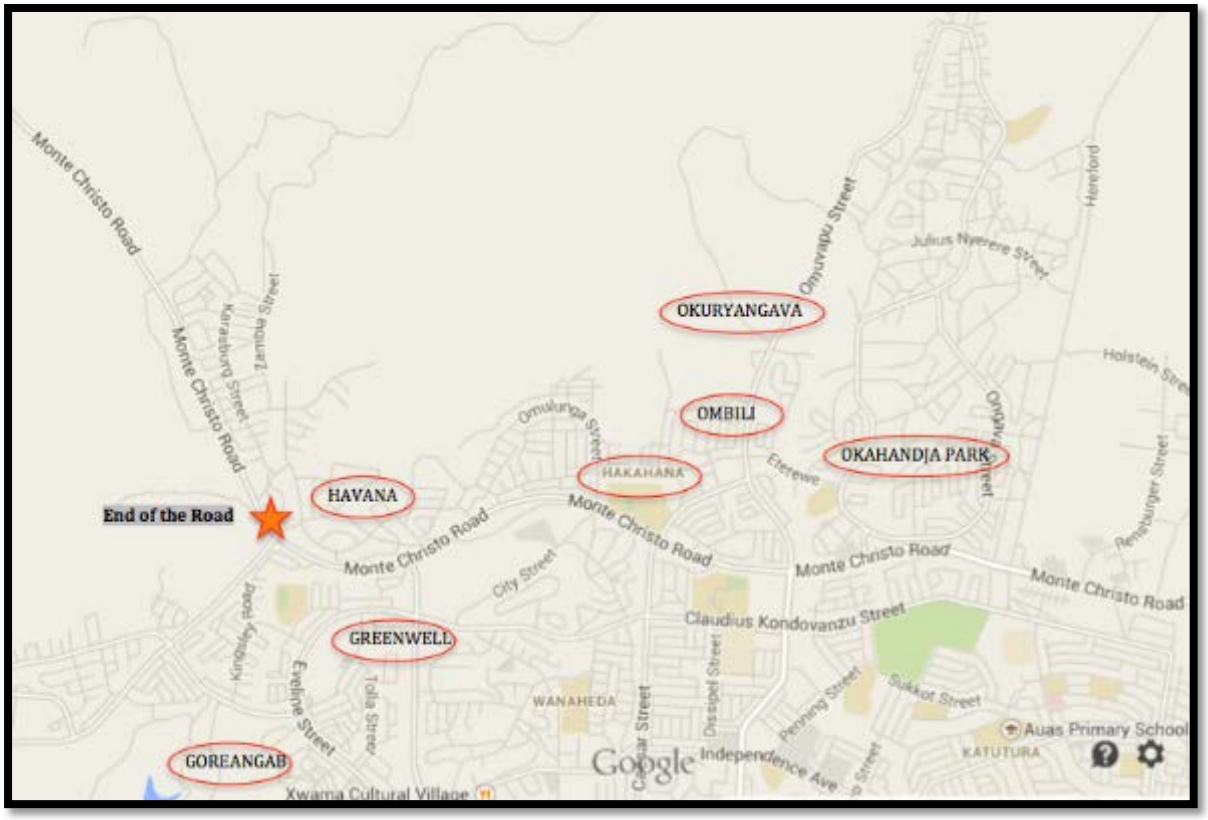

Figure 15: Map of Katutura showing different communities of informal settlements ("Google Maps," 2014)

Figure 16: Open market at The End of the Road in Havana

Figure 17: The End of the Road region in Havana

Figure 17 shows that this area is densely populated and the kambashus are spread over the mountains. Most people in these areas do not have electricity, but the few who do often illegally rent it out to their neighbors. Evidence of this can be seen along the dirt roads, where the shallowly buried wires are often unearthed by rain or foot traffic, as seen in Figure 18.

Figure 18: Buried electrical cables installed by local residents

The majority of the businesses in our project area are bars and shebeens, a local term for unlicensed bars. They are located along the main roads and are even more prevalent deeper within the communities, away from the main road. Aside from shebeens, there are also small stands set up along the side of the roads selling a few types of fruits and vegetables, paraffin sweets, pre-paid cell minutes, as well as some traditional cooked foods. Some examples are kapana which is meat grilled over an open fire, fat cakes which are fried balls of sweet dough, and goat's head stew. From our observations, these businesses are mostly run by women during the day. About two in ten shops had men running them.

4.1.1 Communication

Although English is the official language in Namibia, most people, especially residents of the informal settlements, do not speak English as their first language. Instead, they tend to speak the language of their tribe as a sign of pride. The most commonly spoken tribal language in Katutura is Oshiwambo. Some of the other tribal languages spoken in the region are Damara, Herero, Nama, and some households speak Afrikaans. While most of the community members we spoke to knew a little bit of English, they did not fully understand the language. This oftentimes became an obstacle for us to build a relationship and connect with the local residents on a more personal level since we could not speak directly with them.

Tessa Olavi, an intern at MSR, and an MSR member named John Apopya, provided insight and helped us with translation whenever necessary. They provided great assistance to our work in the informal settlements and were able to act as guides. Both were fluent in English and Oshiwambo and were familiar with the communities we visited. Although they both live in Katutura, Tessa does not live in any of the informal settlements. However, John lives in the informal settlement of Ombili and was able to help us gain a broader understanding of the community that we wouldn't have been able to otherwise. With their help, we were able to split into two groups when we went to the communities and speak with more people and gather more information in the limited time we had. Because of their familiarity with the communities, they provided a good source of background knowledge about the area, which helped us to make a stronger connection to the community and proved invaluable to our project. For example, Tessa helped us identify the community of our project focus based on her understanding of Katutura. Based on her suggestion we decided to focus on Havana, an area where people are especially reliant on firewood.

However, there were times when Tessa or John were not able to translate our ideas accurately to local residents or when the residents did not understand certain concepts that we were trying to ask. These kinds of situations made communication more difficult. For instance, when we were talking to the owner of a small stand selling sweets and candies in Havana, we asked him about his profit margins for some of his products. He did not understand the concept that we were trying to understand and asked for clarification. In order to address those problems, we used simpler words to describe the questions and asked multiple questions to obtain the answers for broad concepts. We also tried using hand gestures, body language, and objects to express our ideas when needed. Over time, we learned to communicate better with the community and gain more information from our conversations with the people.

4.1.2 First visits to households within the community

At the beginning of our visits, people were very curious about our presence in the communities. Some people stared, some said hello, and some waved at us as we walked by. When we made a stop at a household, adults and children in the neighborhood came over and listened to our conversations with the residents. They occasionally joined the conversation and our interview then turned into a group discussion. An example of this is our interview with the neighbor of an MSR member, in One Nation. The interview first started with the MSR member and his neighbor. As our conversation continued, a man and three women came over to his house to join our talk. Although the women were quiet at first, they had a big discussion about the blocks towards the end as several other women stopped by and asked about the blocks. This influx of people allowed us to gain information from a variety of viewpoints from one conversation. However, we occasionally had difficulty keeping the discussion focused on the topics we were interested in learning about. At first, we had only Tessa as a translator meaning that our conversations hit a bottleneck and we had to be much more aware to keep the conversation on track and extract useful information. At the end of one discussion we had in One Nation, a few of the residents offered us a common local malt beverage, shown in Figure 19 below.

Figure 19: Interactions with residents in One Nation (Photo courtesy of Robert Hersh)

Besides the challenges we faced with facilitating the group discussion, we sometimes had difficulty conversing with the interviewees because of the gender roles in Namibia. Most of the residents we talked to were women because they are traditionally the ones taking care of children and household tasks as well as cooking for the family. The majority of them were very willing to spend time talking to us. However, occasionally when there were men joining our interviews, the women became very quiet even when the subject was about cooking, an activity they performed regularly. During a group discussion we had in One Nation at the home of a male MSR member, we talked to him and the other man present mostly because the women did not say anything or make any comments on our questions. They stood next to each other and silently listened to the conversation between the men and us. At a group discussion with several men and women we conducted at a shop that sold potato soup, one woman even turned away when she was answering our questions. It was challenging to gain accurate feedback in these situations because the women were the ones using the blocks to cook. To address this type of issue, we learned to direct our questions toward the women and give them our attention while at the same time trying not to ignore any of the other residents we were with.

In addition to understanding the intent of our questions, we sometimes struggled setting up interviews or a following up with community members because of their work schedule, traveling, or cell phone related matters. As an example, one of our pilot testers in Havana got a

job in which she works seven days a week from early morning to five o'clock in the afternoon after we visited her house and gave her some blocks to test. We were not able to revisit and ask for her feedback about the blocks. We tried to contact her via cell phone but received no response. We later heard from her neighbors that she was not allowed to use her cell phone at the work place and that was the reason she did not pick up. In another example of this problem, a pilot resident who also lives in Havana had to travel to the north for a couple of weeks the day after we asked her to try using the improved design of the blocks. We contacted her several times hoping to receive some feedback to continue our development of a better paper block but unfortunately, she was still in the north at the time and did not have a chance to use the blocks before she left. In these cases, we could not do anything but find another family to substitute for the withdrawal of one, even though it took more time.

From the start, we understood that it was going to take a dedicated effort on our part to work efficiently with the communities. We tried our best to show the people that we were here to learn and to help. We endeavored to be outgoing and friendly with the residents by greeting them in Oshiwambo, smiling, and waving when we arrived and before we left. With Tessa and John's assistance, we were able to approach the community more easily and gained useful knowledge for our project. People were interested to hear what we were doing in the informal settlement and wanted to know more about the paper block. From Tessa's insight, local residents thought we were staff from a Namibian government organization because we were clearly out of place in the communities, walking around with a translator and visiting people at their homes. Many times we heard people shout out, "give us jobs" as we passed by. After Tessa or John introduced us and explained why we were there, people understood and shared information with us. Most people were very friendly and even agreed to our request of taking a photo of them for our personal reference. As our project progressed, the community members became more familiar with our presence and more comfortable talking to us, especially our pilot testing families. We also strove to maintain the bond we created with people by greeting them when we happened to see them on the street. We printed the photo we took with a resident in One Nation who was very enthusiastic about our work and sent it to her. We wanted to show that we valued the time and help that local residents provided us while we were there.

4.2 Current Cooking Methods in the Informal Settlements of Katutura

After familiarizing ourselves with the local communities, we began to focus on the specifics of our project. We wanted to learn about the cooking practices of local residents in the informal settlements. To accomplish this objective, we visited four different communities of Katutura: Havana, Ombili, Okuryangava, and Okahandja Park. We decided it would be best to work in a single community due to the limited amount of time we had to conduct our research. It would allow us to gain a deeper sense of how people collected and used wood and other fuel sources in the community of choice, and how residents went about their daily lives. After about a week of learning about the different communities, we decided to focus our efforts in the community of Havana. In Havana, more residents tend to have little to no access to electricity, or electric stoves and therefore rely on firewood much more than in other communities. They also tended to be much more reliant on traveling a long way to obtain their wood due to living away from the center of Windhoek, or paying high prices because of the great necessity of wood within the community to support the large population.

On our first visit to Havana we spoke with one woman who was lighting a fire in preparation to cook fat cakes for her small shop. She was having some difficulty getting the fire started as it had rained the night before and the ground was still wet. In order to help her set the fire she was burning a plastic bottle and splashing paraffin on top of her planks. Upon closer inspection we noticed that her planks were pieces of medium density fiberboard (MDF), an engineered wood made by combining pieces of other woods together with binders and applying pressure. Burning either MDF or plastic can have serious health effects. When we learned that these practices were widespread in Havana, we found a deeper need for our project than we originally anticipated.

Our personal observations and interviews allowed us to learn about the daily life of community members in many ways. People usually cook twice a day for lunch and dinner. In the morning, some people had tea served with bread, while others had oat porridge. Some people did not use wood, but instead used paraffin or gas stoves to make these types of food. Around ten o'clock in the morning, people build a wood fire outside to prepare lunch. Since we usually visited the communities from nine to eleven o'clock, we were able to observe some families cooking. A picture of a local resident cooking goats heads, known locally as smileys, can be seen

in Figure 20. Most of the residents we talked to ran a business in which they sold cooked food. Around five o'clock in the afternoon when it cooled down, people made dinner. Some common types of food people had for lunch and dinner were porridge and soup, or macaroni. We wanted to learn the techniques people used to make fires and how the original blocks performed from the perspective of a resident first-hand, so we gave some of the blocks to a few pilot residents and asked them to use the blocks in their fires.

Figure 20: Resident of One Nation cooking goats heads over a wood fire

From our visits to the communities, we learned that local residents use firewood, a paraffin stove, or a gas stove to cook their meals. Nearly every resident we talked to used firewood and many of them also owned a paraffin or gas stove for the times when they could not use firewood.

4.2.1 Firewood

In the communities, we had the chance to watch people cook with firewood. Most residents set up three large stones in a triangular pattern, seen below in Figure 21, and built the fire in the middle. Once the fire was started, a pot or grill rack was placed on the stones so that food could be prepared. The fires were built fairly large to cook any kind of meal effectively.

When the people had finished their cooking, they doused what is left of the logs with water to extinguish the flame. They then allowed the logs to dry and re-used them for another meal. This technique allowed them to stretch the resources they had and use less wood.

Figure 21: Typical setup for making a wood fire in the informal settlements

After observing the entire process of cooking over a wood fire, we were interested in learning about how people obtained the wood that they used, which varied from person to person. Some residents spent five to seven hours walking to forests to collect and cutup dead branches and trees. They do not cut down live trees for wood because, according to Namibia's Forestry Act, it is illegal for a person to cut down or sell a forest product without a license. This law prohibits any resident of Namibia from cutting down and distributing wood from live trees in communal forest regions. Residents usually travel to gather wood in groups of two to four people because of the possible dangers they encounter along the way. Most people mentioned the presence of snakes. A few said that they are afraid of encountering criminals. When we asked one resident in Havana, who sells goat's head stew and fat cakes, if she goes to the forest to collect wood, she immediately responded that it is too risky for her to do that now, though she used to. Although she did not go into detail about why she stopped collecting wood in the forest, she mentioned briefly that there were men doing illegal things there and it seemed clear to us that

she had a bad experience while collecting wood in the past and she was not comfortable saying any more about it.

In addition to forests, people also travel to farms to collect wood. One resident of One Nation, noted that people who go to farms to collect wood sometimes get chased away by the owners or their workers. She explained that earlier on, people were allowed to collect wood in the farms without a problem. However, many residents started cutting down live branches and trees. Now, many ranchers do not allow people to collect wood on their properties, even if it is already dead. One wood vendor that we met on the side of the road in One Nation shared that he got his wood from a farm. However, he mentioned that not everyone is allowed to do that. He and many others must develop a trust with a rancher over time so that they are allowed on the land to clear dead scrub. Much of this wood is dead mopane and camelthorn.

Since some of the farms are quite far away from the informal settlements, some people need to take cabs or pay someone they know to borrow their car to travel to collect wood. Each trip ranges from tens to hundreds of Namibian dollars depending on how far they travel. They usually collect enough wood to last a month or more. One resident owned a truck, and her husband would drive her to forests that are 300 kilometers away towards Walvis Bay, to cut down branches of large trees once a year. It was unclear to us if these trees were dead or alive when she cut them down but we did not want to press the potentially sensitive issue.

Although wood from branches is commonly used in the communities, wood from pallets is used often as well. A resident in Havana who sold fat cakes and some vegetables in a small stand set up by the side of the road shared that she would usually go to a dump site near her home around five o'clock in the morning to collect broken pallets and other scrap lumber. She had to go early because other people would also go to collect the wood.

Some people have no choice but to spend hours collecting wood due to a lack of disposable income, while others opt to do so because they prefer to spend their money on other goods and services. Other people spend significant amounts of time collecting wood because that has been the way they have traditionally gotten their wood, and they have no desire or need to change it.

4.2.2 Availability of wood within informal settlements

In addition to our interest in how local residents obtain firewood, we also wanted to learn about its availability within the informal settlements. In our interviews, residents of the informal settlements consistently indicated that wood was becoming harder to find because over years, trees near the informal settlements have been cut down extensively. One resident who owns a kapana stand in Havana explained that before 2005, her neighborhood had lots of trees and she got wood from cutting branches outside of her house. Nowadays, the same neighborhood is lined with houses with trees only present every few houses. Another local resident explained to us that even though there were laws against cutting trees in the past, the local government was not able to stop people because of the large numbers of people doing so. Many people reported that they must now travel much further to find wood than seven to eight years ago. They also noted that the price of wood has increased and that the shops and businesses that sell wood frequently sell out of their supply. Previously, residents could purchase ten pieces of wood for N$7, but now residents must pay N$10 for five to seven pieces of wood.

Although wood has become more difficult to obtain throughout the informal settlements, there seemed to be almost no social tension surrounding the collection and use of wood. Most residents noted to us that they would openly share, as well as collect, wood with their neighbors. One resident contrasted this view by noting that she did not discuss wood with her neighbors. She was unaware of how much wood her neighbors had or where they got their wood. She also noted that people sometimes trespass onto farms or ranches to steal wood that may or may not already be dead.

4.2.3 Wood vendors

As part of our work in understanding the use of firewood in the communities, we interviewed wood vendors who sold small bundles of wood by the side of the road. As mentioned previously, the wood vendors would travel to farms or places where trees had been cut down for new construction to obtain their supplies. They would then put about five to seven pieces of the wood into a package and sell them to local customers for N$10. An example of these bundles can be seen below in Figure 22. The vendors only collect wood intermittently and therefore only sell wood for a few days of the month until they sell out of their supply. Residents

who did not have time to go collect wood or did not use wood on a daily basis choose to buy wood from the local vendors when needed.

Figure 22: Bundles of wood from trees, typically sold for N$10

Since natural wood is not always available in the market, wood from pallets is also sold in the communities (Figure 23). One resident shared with us that she bought a pallet for N$20 because companies or businesses who owned these pallets just wanted to dispose of them and by selling them, they could make money to cover their waste disposal costs. With one pallet, the woman could cook several meals containing meat. While the pallet wood is only intermittently available they are slightly cheaper than wood cut from trees, and many residents will use them as their cooking fuel.

Figure 23: Bundles of pallet wood, typically sold for N$10

4.2.4 Cost of wood versus thermal value

We discovered that although most local residents would use any type of wood to cook, some preferred denser wood, such as camelthorn, which produces long lasting, hot embers. When buying wood from vendors within their community, residents look for this variety. Local residents called these dense varieties “strong wood.”

Wood from mopane trees was also considered strong and used by owners of kapana stands who sold braai-ed meat similar to those seen in Figure 24. This wood was also used to make charcoal. Mopane wood is especially expensive. Depending on availability, this wood could cost anywhere from N$10 to N$40 for a single piece that is slightly larger than a paper block. One piece of this wood could last up to two hours when burning and its coals could provide heat for a long time.

Figure 24: Kapana stand with 'strong wood' used to braai meat

4.2.5 Paraffin and gas stoves

The alternatives to firewood in the informal settlements include stoves that use either paraffin or propane gas. One factor that drove people to use these alternatives is weather, specifically rain. Only three of our 25 interviewees told us that they could not afford a paraffin or gas stove, and therefore they usually did not cook on rainy days. Those who had businesses that sold cooked products such as goat’s head stew, potato soup, or fat cakes, had to close their shops

on these days because they could not cook outside. Others, who could afford to cook using paraffin or gas, did not encounter such problems when it rained.

Paraffin and gas stoves were usually used to cook light meals like porridge and macaroni. The residents mentioned that they could not cook meat or a meat stew using paraffin or gas stoves because it takes far too long and costs too much. Many residents noted that cooking over a stove takes longer than cooking over firewood. One woman specifically told us that a meal that could be cooked outside over a wood fire takes approximately half of the time it would take to cook inside.

Both paraffin and gas stoves have a high starting cost. The stoves themselves are sold for approximately N$100 each and involve an additional, ongoing, cost for fuel. A typical paraffin stove is shown in Figure 10 in Section 2.4. According to one informal settlement resident we spoke to at a gas stove and refill shop, a three-kilogram tank of gas is typically sold for N$70 and lasts around a month if used sparingly and in addition to the use of wood. On average, a liter of paraffin costs N$15 and can cook about three light meals. Meanwhile, N$10 worth of wood could allow a family to cook one or two heavier meals that take longer to cook such as meat and corn. Although the cost per meal is more expensive for wood, wood can be used for more common foods that also require more heat and time.

4.3 The Paper Block

After we gained a general understanding of current cooking practices and common cooking fuels in Katutura, we were interested in the perception of community members toward the existing paper blocks. We distributed several of the original paper blocks of different compositions to seven families and asked them to pilot test them for a week. We were able to follow up with five of the pilot families who all gave us some great feedback. The other two pilot testers were unable to give us any valuable information for personal reasons. One woman returned to her family home in the northern part of Namibia and one found a job and was working from early morning until evening every weekday. When we tried contacting the woman who got the job, her phone was disconnected and we were unsuccessful in following up with her. The families we were able to follow up with gave us useful insights that we would not have found on our own.

All of the pilot testers told us that they were interested in the product and that it could be particularly helpful during the rainy season. They unanimously reported success in using the block as a fire starter, but pointed out that they were not satisfied by the current cooking value of the block on its own.

The major drawbacks that they reported were that the block produced a weak and fickle flame that could not be used to cook, and that the block produced too much smoke and ash as seen in Figure 25. Some reported success in boiling water with the blocks alone, but most people needed to add firewood in order to complete their cooking. When used alongside firewood, the block met the expectations of the users. Most users used less firewood when using paper blocks, and one family reported using half the amount of wood they normally would. However, everyone had a slightly different method of cooking and one family reported no reduction in their firewood use. While they were all unsatisfied with the block's performance, they all mentioned that if the block were improved they would be interested in using it on a more consistent basis.

Figure 25: Smoke and ash resulting from burning a block of the original design

One other significant drawback of the block was that pilot families were unable to use the block to braii meat since the blocks burned to ashes instead of coals which did not hold heat. Since braai-ing plays a large part in the culture of Namibia, and is a significant consumer of

wood, this is a major drawback. One pilot tester, an MSR member, told us specifically that the number of disadvantages to the existing paper block outweighed the advantages it provided.

4.3.1 Comparative study between current paper blocks and firewood

In order to address some of the concerns of the pilot families, we conducted a comparative study between the current blocks and firewood to evaluate the product quality. Qualitative testing was performed as documented in the methodology chapter. Blocks of the original design were tested in both the fuel efficient stove built by Tomas Shilongo, an MSR employee, as well as in the open air typical of the method used by residents in the informal settlements. We tested blocks of varying compositions: strictly office paper, office paper and sawdust, and newspaper and sawdust. The blocks were part of a pre-existing supply and we were unable to distinguish the exact proportions of the ingredients, but we were able to distinguish by sight the different materials present.

We started a timer when we began trying to light the fire and made observations noting the time. We observed the blocks as they burned looking for things such as ash and smoke produced, as well as the number of times the flame needed to be tended too. We used a stick to prod the fire and a piece of cardboard to fan and coax flames from the blocks whenever necessary.

We observed the blocks made with newspaper and sawdust to be the best. The blocks with solely office paper performed the worst in both the open air and homemade stove. These blocks were incredibly difficult to coax a flame from and smoldered for most of the approximately half hour it took to burn. Vigorous fanning and scraping ash off of the side of the blocks were relatively ineffective but were the only way to get even a short lived flame from the block.

The blocks made of office paper and sawdust were very similar to the newspaper and sawdust blocks. However, in our observations, the office paper did not perform quite as well. Flame was difficult to produce and sustain on all of the previously designed blocks however the newspaper and sawdust required the least prodding and fanning. The qualitative testing led us to believe that the blocks needed to be redesigned and that the optimal block would contain a mixture of newspaper and sawdust. For our full notes on these tests see Appendix H.

4.3.2 Development of a better paper block

Based on feedback from the pilot families and our qualitative testing, we identified two main failings of the previous paper block. The block produced a fickle flame and far too much smoke and ash. We observed that when the flame was going stronger the amount of smoke and ash was reduced. This meant that we could address both issues by creating a block that burned more consistently.

In order to accomplish this we aimed to increase the surface area to volume ratio of the paper block and increase the amount of airflow to the flames. Increasing the surface area increases the amount of area available to be burned. Fire thrives on oxygen and the densely packed blocks of the previous design suffocated the fire. We believed that making these two changes would result in a better burning block.

We decided to add holes running the length of the block through the center so that there would be a channel for oxygen to reach the heart of the flames. The holes also provide more surface area to the block. We created the holes using 1cm diameter metal rods placed in the center of the mixture as the block was molded as seen in Figure 26 and Figure 27. We compressed the bricks less than the amount done previously so that there would be air pockets within the block itself. The air pockets open up during burning to allow more airflow to the block. Finally we reduced the overall thickness of the block by half. With the change in block dimensions and inclusion of the rods, we were able to more than double the surface area to volume ratio of the paper blocks from 0.719 to 1.549. The increase in surface area gives the fire more area to spread to and grow allowing it to burn stronger. For more detailed instructions on how the paper blocks were manufactured see Appendix I.

Figure 26: Metal rods being inserted during the molding process

Figure 27: Shape of finished block made using new design

It was important that we tried to make a connection between the community members and MSR to include their input while redesigning of the paper block. To accomplish this we asked everyone we interviewed for ideas about how we could improve the blocks and if they would be interested in coming to MSR to be part of the redesign process. Some of their suggestions were unfeasible or even unsafe, such as putting plastic in the mixture in order to help the blocks burn, but generally, we wanted to make sure we took their opinions into consideration. For example, one of the community members, Simon, came to the MSR office and helped

manufacture about 70 paper blocks using the new design that we developed. He suggested that we place four sticks approximately the thickness of his thumb into the blocks during the molding perpendicular to the holes we had been making. We explained that we wanted to avoid using wood as much as possible, but that we would try making them his way and test them alongside our own designs. The next section discusses the results of our testing of the redesigned blocks.

4.3.3 Testing performance of new design paper blocks

After re-designing the paper block, we tested different compositions to try to determine which blocks burned the best. We also tested blocks that were made by breaking down blocks of the previous design, re-soaking and remolding the material into the new shape. We hoped that we could prove that this was a viable method to recycle the existing stock of blocks. We performed quantitative tests to determine the heat transfer rates and properties of different compositions of the new blocks, which we compared to the previous block design, and wood.

Our quantitative testing was performed as documented in the methodology chapter. We found that the block with a composition of two parts paper, either newspaper or office paper, to one part sawdust performed the best, and the two parts of either paper to one part sawdust with sticks block performed the worst. The three key areas we looked at to form this conclusion were time taken to reach maximum temperature, maximum change in temperature delivered, and change in temperature per minute. We also made observations on ease of use, predominantly the number of times the fire needed to be tended to in order to maintain a flame.

The graph in Figure 28 below shows the maximum change in temperature of the water. It was important that we rely on the change in temperature data as opposed to maximum temperature recorded because the water did not always start at the same temperature. The graph shows the average of the four trials run on each type of block except for the two blocks with sticks in them and the two parts sawdust to one part paper and wood, where we were only able to run one trial each. We were only able to gather enough sticks to make one of each of the blocks with sticks as Simon suggested. The two parts sawdust to one part paper blocks were incredibly fragile and fell apart even as we were molding them. For this reason they were deemed impractical and only one was tested.

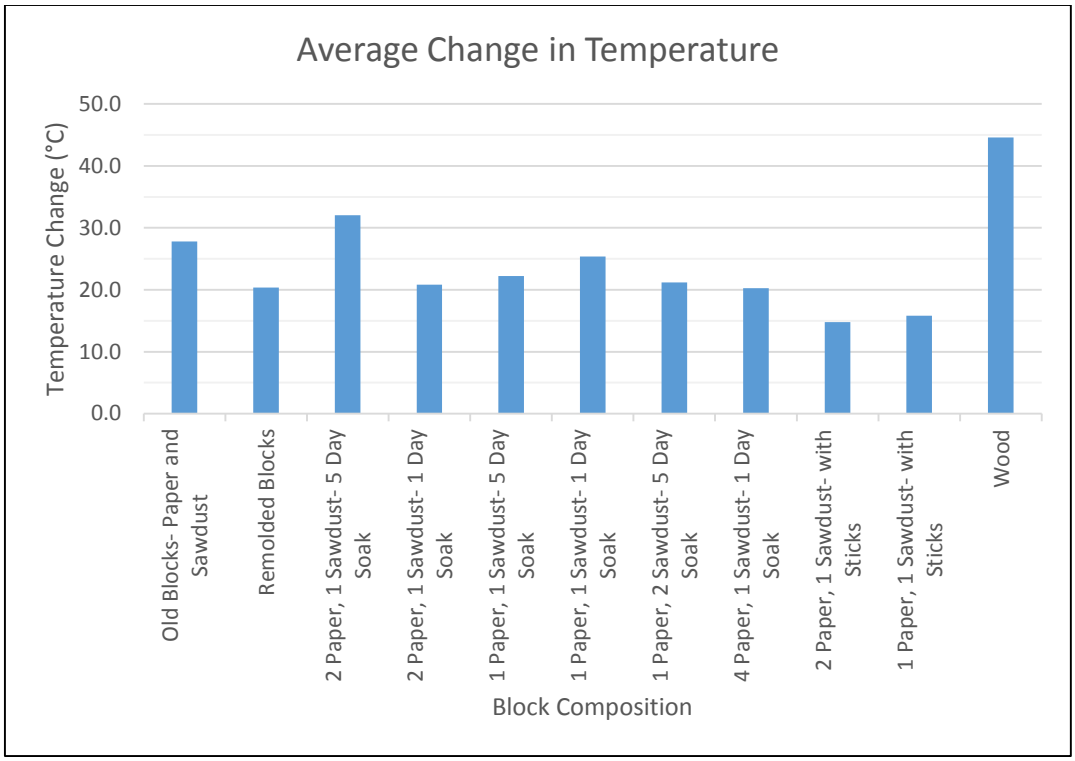

Figure 28: Graph of Average Change in Temperature

The graph above shows that of the blocks tested the two parts paper to one part sawdust block performed the best. It raised the temperature of the water an average of 32.1°C which was an approximately 10% improvement over the previous design. The only thing that performed better was firewood, which raised the temperature of the water 44.6 °C. The worst performing block was the two parts paper to one part sawdust with the sticks inside which raised the temperature of the blocks 14.8°C, less than the previous design of the paper block, and was more difficult to keep alight than any of the others tested. We were surprised by this result but when the one part paper to one part sawdust block with sticks performed similarly, it confirmed the results of both tests.

The graph in Figure 29 below shows both the time taken for the water to reach maximum temperature as well as the time taken for the block to burn completely.

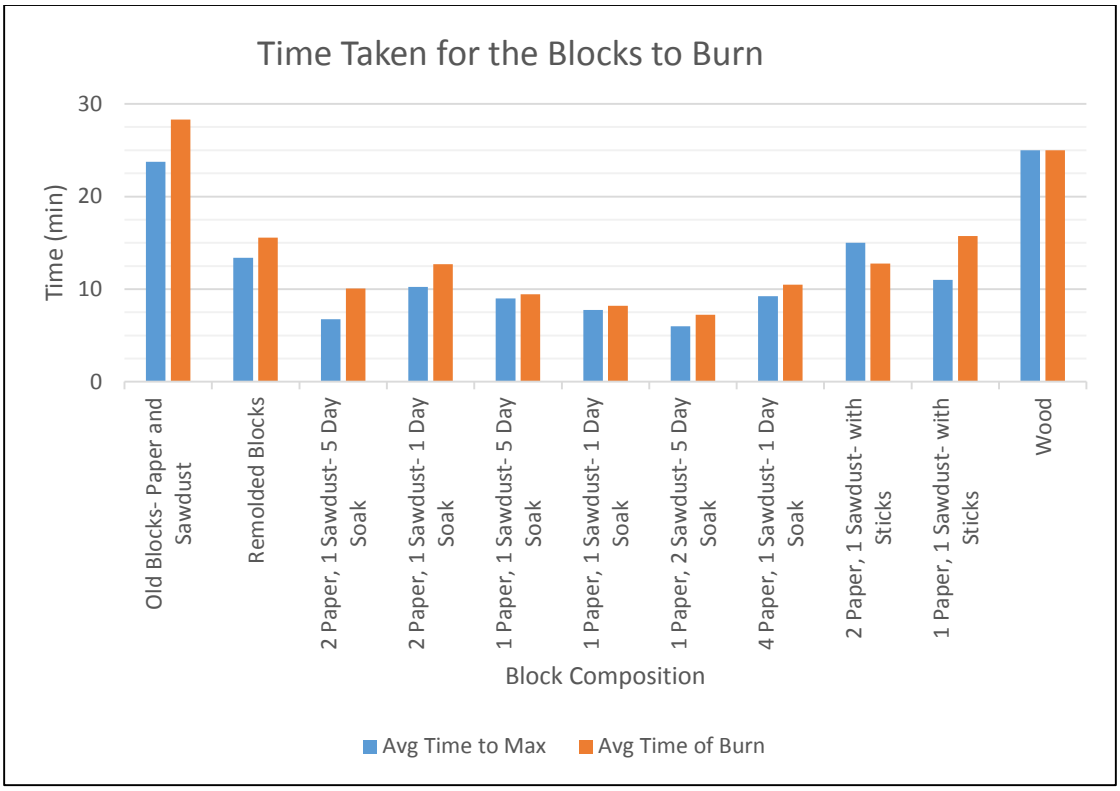

Figure 29: Graph of Time Taken for the Blocks to Burn

All of the blocks we designed burned faster and easier than the old design. Burning faster is not necessarily a desirable trait, however because the time taken to reach a comparable maximum temperature is so much less, cooking can be done faster. While it is necessary to use more blocks than firewood, the blocks are easily made from waste products and can be readily available. The newly designed blocks burned quickly and hot. The fastest burning block was the two part sawdust to one part paper burning in 7 minutes 15 seconds and reaching its maximum temperature at 6 minutes into the test. The flames from our fires were too high for our infrared thermometer to measure. Meanwhile, the firewood was consumed slowly and took longer to heat up the water. The test was stopped at the 25 minute mark to keep it similar to the tests run with the paper blocks. Although the temperature continued to rise up to the point when we stopped the test, the rate at which the temperature grew had significantly reduced.

The final graph in Figure 30 shows the average rate of change of the temperature in degrees Celsius per minute. This is the most important graph since it puts all of the materials on an even footing and allows for the most direct comparison.

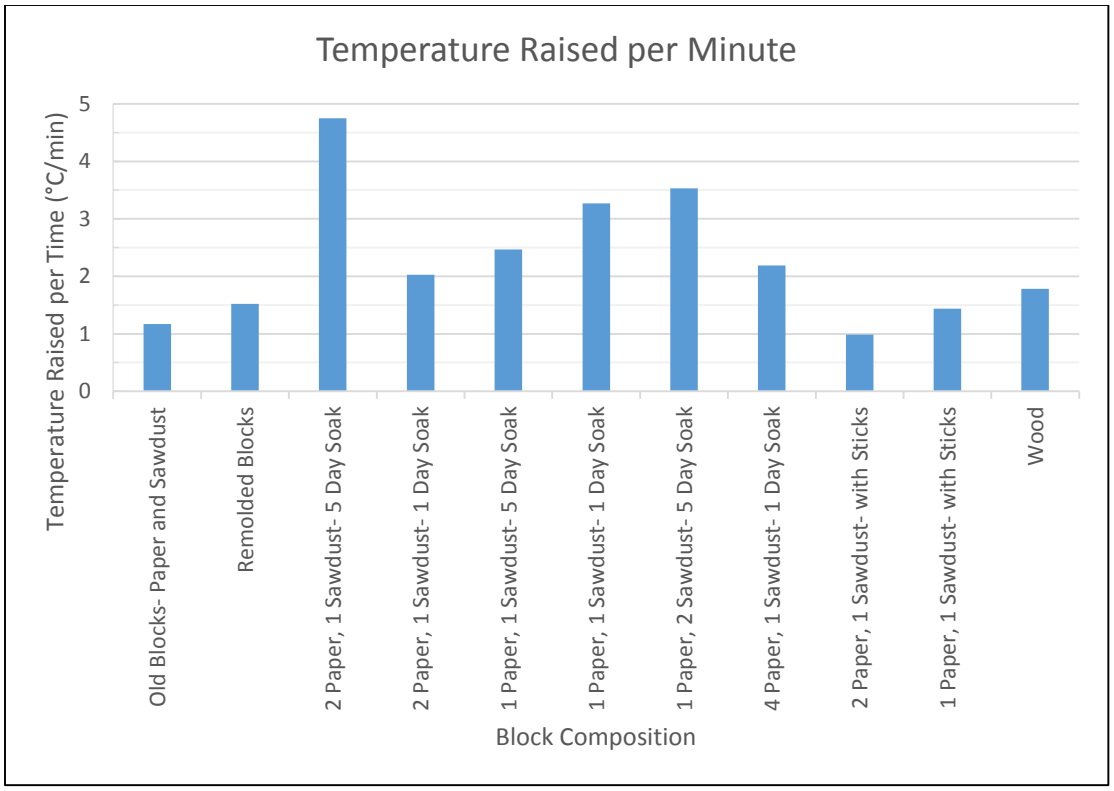

Figure 30: Graph of Temperature Raised per Minute

From the graph, it is clear to see that the two parts paper to one part sawdust block performed the best raising the temperature 4.78 degrees per minute. Firewood only raised the temperature by 1.78 degrees per minute meaning that it requires much more time to cook a meal. The worst performer was once again the 2 parts paper to 1 part sawdust block with sticks inside which only raised the temperature 1.0 degrees per minute.

Our testing confirmed that the newly redesigned blocks burned for a short time but produced an intense heat. We also proved that, while not ideal, recycling the existing stock of paper blocks was viable. For our full quantitative testing data, see Appendix JAppendix I.

4.3.4 Local resident using the new design paper blocks

Moving forward, we wanted to understand the reaction of local residents towards the new design blocks. We asked a local resident named Ndakondja, a neighbor of one of our pilot testing families in One Nation, to cook traditional pap, a thick maize porridge, (Figure 31), using the paper blocks while we observed. She used six of the paper blocks made from re-soaked materials and remolded into the new shape and cooked for a total time of approximately 15 minutes. She described that the food turned out the same and tasted the same and was just as easy to cook. The

fire died five minutes after Ndakondja finished cooking. The ashes continued to produce a significant amount of heat for the next ten minutes. Since the two parts paper to one part sawdust block performed better than the remolded blocks which were used for this test, we believe that it will take fewer blocks to cook the same meal with the two parts paper to one part sawdust blocks.

Figure 31: Local resident cooking porridge with the newly designed blocks

From our findings, people who cook for their families spent approximately N$10 per day while those who cook more commercially spent approximately N$10 per meal. We estimated that a meal can be cooked over four to five of the two parts paper to one part sawdust blocks, therefore the blocks should be able to compete at an approximate retail price of N$1.50 each, meaning that one meal would cost approximately N$6-7.50.

4.4 Disseminating Information within the Informal Settlements

After successfully improving the performance of the paper blocks, we moved on to address other problems that MSR has had over the last three years raising interest in the blocks. We began by better understanding how information is disseminated in the informal settlements in order to design a successful business model and spread the word about the Paper Block Project to the communities. The first group of store owners we chose to talk with were the owners of the

small shops and stands on the edges of informal settlements. We wanted to understand what drove their choice of location and the products they stocked. Many of the storeowners were women who began their shops as an extra source of income during the day while their husbands were at work. The store owners would try to sell all of their goods within two or three days and buy more inventory in the mornings when they needed to. They got most of their supplies from the Stop-N-Shop, a large local retail store located in Okuryangava. They would either take a taxi or travel on foot carrying their goods to their stores. When the store owners are first starting out, they tend to buy a product or two that they know will sell well, and slowly save up money from their profits. When the store owner then has enough money, he or she will invest in a new product. A lot of the smaller stands sell a variety of smaller individual items such as nuts, candies, prepaid cell phone minutes, and a selection of fresh fruits.

Observing the stalls at the Three Way Stop in Havana, we noticed that they only seemed to differ from each other by an item or two One store owner we spoke with explained that not all products that they try to sell catch on and sell like they would have hoped. For example, she tried to sell matches a few years ago. She thought this might be a good idea since almost all households in the informal settlements use matches to light their fires regardless of fuel used. However, the matches did not sell for some reason. We noted that the entire stall that she shared had no sort of advertising for the businesses or products. As we met with and observed more businesses that used stalls, we noticed that this trend continued.

As we moved around and talked to businesses who utilize permanent buildings to serve as their shop, we noticed that they tended to use signs to advertise their presence. Many businesses had signs a few feet from their shop to attract the attention of potential customers, as well as signs to advertise a product or service that they offered if it was unique to their store. In Havana, we talked to a business owner who had several signs, which included a few about his shoe repair service as well as one about prepaid cell phone minutes. In Ombili, we came across a store that sold gas stoves and gas to people that used a sign along the road to grab the attention of passers-by. After talking to a few business owners, we began to realize that they seemed to get started and sell new products the same way as the smaller stands.

Walking around the informal settlements, we came across a plethora of bars and shebeens on the main roads. Large signs seemed to cover their entire storefront advertising the beers, other drinks, and other small products that they offered such as prepaid cell phone minutes. In addition

to shebeens, hairdressers and barbers are also very common within the settlements. It was very apparent where they were because of the use of a store front sign, as well as signs showing what hairstyles they were able to give people. The signs used for small businesses were generally hand-written using paints. Typical signs used by bars and small business owners can be seen in Figure 32 and Figure 33 respectively.

Figure 32: A large sign advertising beers in front of a bar in Havana

Figure 33: A typical sign used by small business owner in Havana

Talking to local residents, we tried to gain a sense of how people knew about different stores, products, and businesses. Most people we talked to told us that if we wanted to spread word of the paper blocks, the best ways to do that would be through the use of a community meeting or with a radio advertisement on Namibia Broadcasting Cooperation (NBC) Oshiwambo Radio. As we conducted interviews, it became more and more apparent that many people rely on radio for their entertainment and music throughout the day. The community meeting also came up time and time again, so we looked towards the community council to understand how to set one up and how word would be spread.

We found that the community council can be a great asset in furthering the Paper Block Project. The council is made up of elected representatives for the communities. They work with community leaders, who are also elected, to serve as a voice for the people in the communities in government. We contacted representatives of the community council to get their approval to do our research in Havana. We spoke with Hon. Apisai Angula of the Samola Machel constituency and Hon. Martin David of the Moses Garoeb constituency. Havana is split between these two constituencies and it was important that we go through both channels. Both councilors asked what we had been doing in the community, and after we had assured them that the paper blocks were safe to use and that we were there collecting data, not money, gave us their approval to move forward with our work.

We learned through these conversations, as well as interviews conducted with residents of the communities, that setting up a community meeting would be a good way to raise awareness about the paper block. Community meetings are usually held approximately once a month and deal with local politics, new products, and upcoming events relevant to the community. These meetings are organized by a community leader who will walk or drive through the streets with a megaphone announcing the time, date, location, and subject of the meeting. We learned that many people will attend these meetings, especially if they are held on a weekend. We were also warned that people will leave the meeting if the subject matter does not hold their interest.

4.5 Evaluating the Previous Business Plan

The next step of our project was to evaluate the past marketing plan of the Paper Block Project. We interviewed Hilya Kambanda and Tomas Shilongo, MSR employees, to obtain this

information. From our interviews, we learned that MSR used pamphlets and also had Pius Shambabi, the project coordinator at the time, travel door to door attempting to sell the blocks. Pius was able to talk to a few people and start raising awareness by word of mouth but it was a slow process. We also looked through the file the MSR kept on the progress of the project. This folder was unorganized, but we were able to find records of payments made to people producing the paper block. The files only had records of the total payments without a connection to the number of blocks made.

We followed up with Pius Shambabi hoping that he would be able to give us more information. We learned that in the past, he and one other MSR member went out into the community to sell the blocks by going door to door. We learned that this strategy failed in both raising awareness and selling the blocks. Pius was only able to take approximately 40 blocks at a time into the community which he would then try to sell for N$1 each. After paying the N$18 in roundtrip taxi fare to get to and from MSR's office and having to give MSR 50% of the total earnings, he was left with very little remuneration for his efforts. Additionally, moving through the communities he had no constant location, which made it hard for potential repeat customers to find him. This practice was discontinued more than a year ago and at the time of our project the only source of information for potential new costumers was the MSR digital monthly newsletter posted to their website. Those who did hear about the project and came directly to MSR to purchase blocks rarely returned to buy more.

The next step was to find out what the public knew about the paper block. In the communities, we found that none of the people we interviewed had heard of the paper block project and only a handful had heard of MSR itself. Promisingly, all of the people we talked to were interested in reducing the amount of firewood they used even though they had never been exposed to the paper block project. Two of the people we talked to had worked on similar projects in different parts of Namibia in the past but could not remember the names of the organizations involved.

At MSR, we participated in an MSR member community meeting held April 8th, 2014. We were given time to talk about our project and what we were doing with MSR. Despite the paper block project having been underway since 2011, only two of the seventeen members in attendance were familiar with it. The individuals who had heard of the project before helped to make paper blocks two years ago. Although the project had ceased to progress two years prior,

and took a turn towards insulation, MSR seemed to also stop recruiting members to try to improve the product or tell its own members, let alone people in the community, about it.

4.6 Creating a New Business Model

Once we gained an understanding of the state of the Paper Block Project as a whole, we began to develop a practical business model that could be implemented in the future. We wanted to make sure we addressed the failings of the previous business model and advertising strategies.

One of the first things we wanted to make sure of was that the supply of materials needed to make the paper block was sustainable going forward. We did not want to run into a situation where there was significant demand for paper blocks that could not be met because the raw materials necessary for production could not be secured in a timely manner.

We spoke with Hilya Kambanda, an MSR employee, and Janet Wicks, the director of MSR, who told us that the materials had never been a problem to obtain and they could see no reason why there would be a problem in the future. We learned that the shredded paper came from a project now run by Rent-A-Drum, a local waste management company, and that the sawdust came from the Windhoek Vocational Training Center. These materials are free and readily available, meaning that the only cost MSR incurs comes from transporting the materials to the workshop. In the past, Janet Wicks, the director of MSR, used her personal truck to transport the materials. The expense was minimal since the truck, locally known as a bakkie, was her personal vehicle. Going forward the recycled materials should ensure an affordable, environmentally friendly block. As the project scales up, there are MSR members who own vehicles who could potentially transport materials to MSR.

Based on what we learned about the old business model, we created a new business model that primarily focuses on selling to retailers. One of the major drawbacks of the previous model was a lack of a consistent and convenient location. Involving established retailers in the project will remedy that as people already seek out those shops in order to purchase things for their homes. Selling to pre-determined retailers who come to the MSR office on their own will eliminate the amount of time MSR members need to spend selling blocks which allows them to keep more of their effective wage.

Our team worked hard to identify retailers who would be willing to help us get the project off the ground. We have found three initial vendors, Sylvia Shifela who owns a small shop

selling fruits, vegetables and other small household goods, Rauna Kapembe who owns Kaperona Trading Enterprises which makes furniture and sells firewood, Salatiel Moses who owns a small shop selling snack items and doing shoe repairs. Rauna and Sylvia's shops are at an area known as The End of the Road in Havana which is shown in Figure 34 where there are several small vendors gathered into an informal open market. Salatiel is at another informal open market at what is known as The Three Way Stop in Havana shown in Figure 35. All three of these vendors were excited about the project and willing to add the paper blocks to their existing stock of items for sale.

Figure 34: Open Market at the End of the Road in Havana

Figure 35: Open market at The Three Way Stop in Havana ("Google Maps", 2014)

The primary business plan is for MSR members to come in to the MSR office and make blocks. Members should be able to make approximately 100 blocks over the course of an eight hour day. The retailers will then come to the MSR office and purchase blocks for N$1. MSR will collect the money and keep N$0.10 per block for the overhead, which covers equipment maintenance cost as well as material transportation, giving the balance to the MSR members who made the blocks. The retailers can sell the blocks for a recommended price of N$1.50 or at any price they see fit. For a full description and other scenarios see Appendix L.

After completing the new business model, we were interested in gaining feedback from MSR members on our proposed scenarios as well as generating interest among the members on the project. On April 29th, we held our own community meeting for MSR members devoted to the explanation of the whole project, the work we have done, and what MSR members can do to help in the near future. Of the 18 members that attended only one knew about the project beforehand because he had been at a prior community meeting where the project was discussed. We also invited Ndakondja and another woman from the community to share their opinions of the block during our presentation.

The MSR members were very interested in the performance of the blocks. We were able to talk about how the new blocks preformed in our eyes and through tests. Ndakondja talked about her firsthand experience with the blocks. Her word as a member of their community was valued even more highly than ours. Many of the members were curious about how the blocks preformed in comparison to wood, what kinds of and how much smoke was produced in relation to other fuels, and if the use of blocks changed the taste of the food at all. She explained that although she had to use six blocks, the food cooked just as well. She said that food will taste different if it is cooked over a wood fire instead of a gas stove, and that the food cooked over the paper blocks tasted the same as food that was cooked over wood. After much discussion about the ways in which MSR members could participate in the project, eight of the MSR members in attendance were very interested in making blocks and selling them in the future.

Overall, we were optimistic about the development of our project. By successfully improving the quality of the paper blocks, we hoped that the project would continue to develop and create job opportunities for MSR members and local residents of Katutura through the production and sale of the paper blocks.

5 Recommendations

After numerous visits to the informal settlements of Katutura and extensive testing of the paper block, our team has worked to develop a new design that improves the performance of the paper block along with a practical business model that can be implemented in the future. We have developed the following steps that we recommend be taken to help ensure the success of the Paper Block Project in the future. We have broken our recommendations into three sections: The Paper Block Project as a business, development and refinement of the design for the paper block, and the production of future paper blocks.

5.1 The Paper Block Project as a business

We recommend that MSR hire a project coordinator

There is considerable logistical work that must take place in order for the Paper Block Project to function to its fullest potential. In the past, Pius Shambabi was the coordinator for the project, but he is no longer available for employment due to his new job at the Polytechnic that MSR helped him acquire. Under his tenure, the current supply of blocks was manufactured, but due to lack of awareness within the communities among other issues discussed, he struggled to sell the blocks. The coordinator would be responsible for organizing the manufacture of blocks per the request of retailers so as to avoid having an overstock of blocks. Furthermore, the coordinator would be responsible for expanding the project through identifying new retail outlets and new methods for selling the blocks. We expect the coordinator to participate in the project by either manufacturing or selling blocks, or a combination of the two. We anticipate the responsibilities of the coordinator to occupy no more than 10 hours of his time per week. Any money that MSR makes will be used to cover expenses for the project, including payment for the coordinator.

John Apopya is an MSR member who has been working with us for several weeks. He accompanied us to the communities and assisted us as a guide as well as a translator. He was also involved in making the improved paper block and process of block testing. Furthermore, the work he did was entirely voluntary. Whenever we contacted him, he came over without hesitance. Thus John could make a good candidate for this position. For a full job description of the coordinator, including qualifications and responsibilities, see Appendix K.

We recommend that MSR develop a name for the paper block

One way to help the paper block project develop a demand is to create a brand identity. The first step in this process is to come up with a name for the paper block. The name should be in English to be accessible to many different ethnic groups. There were multiple occasions during our community visits where people mistook the paper block for loaves of bread. Therefore the name should also describe fire and cooking to eliminate as much confusion about the project as possible. A catchy name will help any further marketing efforts undertaken by MSR.

We recommend that MSR implements the business model we have developed as a starting point for the project

We have developed a business model that encompasses as many scenarios as possible. We consulted Janet Wicks, Tessa Olavi, and John Apopya to gain their input on the project. Furthermore, we proposed this business model to MSR members to gain information on their perceptions of it. Together, we made sure that all plans were practical and reasonable from both the perspectives of MSR and the community. This business model provides MSR funds to cover overhead costs for the project such as the maintenance of the molds and transportation of the raw materials to MSR. Additionally, it clearly defines the roles and expectations of MSR, the people who manufacture the blocks and the organizations that sell the blocks to the general public. For a formal description of the business models, see Appendix L. For a graphical representation of the business models that we presented to the members of MSR, see Appendix M.

In the future and as the Paper Block Project proves itself to be a valuable product within the community, demand for the product will grow. With this growth, more avenues for production and sale of the paper blocks will show themselves, and MSR members will be able to take it upon themselves to become entrepreneurs and expand how they feel worthwhile and effective. MSR is not looking to hold people's hands through the Paper Block Project, but to empower them to think for themselves and work independently of the organization.

We recommend that MSR continues to identify new retail outlets for the paper block

In our experiences with the community, residents were willing to pay a premium for convenience. For example, instead of walking or taking a taxi to the local supermarket

themselves, residents were willing to pay more for products that were available within walking distance from their homes. We have identified three specific businesses that are willing to add the paper block to their business; their owners are Rauna Kapembe, Sylvia Shifela, and Salatiel Moses. All of these businesses are in the community of Havana, which was chosen because of the high use of firewood among its residents.

Going forward, we recommend that MSR attempts to find new businesses that would be willing to sell the paper block. As demand for the block increases, it will be necessary to find more retailers in Havana, as well as retailers in other communities of informal settlements. When looking for businesses, we found it helpful to identify businesses with the informal settlements where people commonly buy household goods, and focused our efforts there. This is due to the fact that residents are already accustomed to purchasing food and other household supplies from these outlets and would be convenience when they need to buy paper blocks

We recommend that MSR provide retailers with a sign to show that the paper block is sold there.

The most common form of advertising within the informal settlements is through the use of signs. Most permanent businesses will have at least one A3, or approximately 11” x 17”, sign that displays the products or services it provides. These signs also have the cell phone number of either the owner of the business or another point of contact. By providing retailers of the paper block with a similar sign, MSR should hope to raise awareness of the block within the community as well as clearly communicate to customers the location of a retail outlet for the paper blocks. With permission from the community council and leaders, we also suggest that MSR looks into putting signs up near the water taps located throughout the community to help raise product awareness to as many people as possible.

Since the majority of residents of the informal settlements speak Oshiwambo, the written material for the sign should be printed in both Oshiwambo and English. By utilizing these two languages, the signs will reach the vast majority of the residents of the informal settlements and will be extremely helpful in raising awareness about the paper block within the informal settlements. We developed a sample sign that meets these requirements, which can be seen in Appendix N.

We recommend that MSR organizes community meetings with the Moses Garoeb and Samola Machel constituencies.

We have spoken to the Honorable Martin David and the Honorable Abisai Angula, the local councilors who are in charge of the two constituencies that encompass Havana. Both councilors were very supportive of the work we were doing and willing to provide assistance to us. Since community meetings are the official way to distribute information within the informal settlements, we think that participating in a community meeting within each constituency will substantially help to raise awareness about the block within the communities. As use of the paper block grows and spreads to other communities, additional community meetings should be held to ensure that the general public is aware of the product as well as to ensure that the local government is aware of MSR's paper block and its use within each constituency. We attempted to organize community meetings during our time in Katutura, but we were still in the process of developing and testing new paper block mixtures and felt that promoting a product that did not perform up to standard would do more harm than good. It would have given the community members a false first impression of the paper block's effectiveness.

We suggest that MSR work towards creating a cohesive presentation of the blocks that includes MSR members and pilot testers explaining how the product was made and how it performed. A demonstration where the paper blocks are put side by side with fire and used to boil water or cook food would give the audience a way to see that the product actually worked.

We recommend that MSR actively promote the Paper Block Project to its members

In the past, one large factor that contributed to poor paper block sales and demand was a lack of awareness for the project, both within the membership of MSR and the community as a whole. To combat this issue among MSR members, MSR should actively promote the Paper Block Project whenever possible. During visits to roadside job sites, MSR representatives should mention the Paper Block Project directly to the men looking for jobs, highlighting the potential benefits that it could provide to the men such as sustainable income, and the opportunity to start their own business. In addition, MSR should specifically highlight the opportunity to participate in the Paper Block Project to its members at training sessions and community meetings. They should specifically mention that the blocks are easy to make and safe to use. Finally, MSR

should emphasize to its members that the project is an opportunity for them to earn a sustainable income for their families, and they can do that by either manufacturing or selling the blocks.

5.2 Development and refinement of the paper block design

We recommend MSR continues testing Paper Block Mixtures combined with various binding agents in order to develop the best block possible.

Through our testing of various ratios of paper and sawdust, we discovered that while the new blocks burned quite well, they were fragile and could fall apart easily during transport, even with minimal, careful handling. If a binding agent that was organic, safe to burn, practical, and cost effective can be found, we believe that adding it to the two parts paper to one part sawdust mixture will further enhance the overall performance of the block. We started trials using sugar but due to time constraints were unable to conclude our testing.

We recommend that Tessa Olavi, the current MSR intern, be made responsible for this task in the immediate future. Since Tessa has been observing the testing process we have used, she will be able to conduct tests that are most similar to what we would do ourselves. Tessa is completing her internship in June and will no longer work for MSR. Due to this fact, it is important that MSR works towards having one of their members take on the responsibility so that when Tessa leaves, the project doesn't stop improving. John Apopya has also observed our testing methods and should help Tessa develop and test new compositions whenever he is able to do so. If John is to work as the project coordinator this could help him gain a better understanding of the project as a whole, and become more invested.

5.3 Production of future paper blocks

We recommend that all future paper blocks be made with the new design we developed.

Our testing showed that, independent of the material composition, blocks that were approximately 2.5cm thick, lightly compressed, and had holes running along the length of the block burned significantly better than the original design. Due to the increased airflow through the blocks, the blocks were able to burn much hotter and sustain a flame more consistently than the original design, and our tests proved that they heated a pot of water much quicker than wood.

In the communities, the feedback we got concerning the new design was extremely positive. Most residents indicated that they saw a noticeable increase in performance, which we confirmed with our own testing.

We recommend any new molds that MSR procures in the future be designed to easily manufacture the new design.

When our team produced blocks at MSR, we used the old molds that were used to create the original supply of blocks. While it was possible to manufacture the new design using this mold, it required substantial measuring in order to create a consistent, uniform product. This process was time consuming and labor intensive. We have included designs for a new paper block press, optimized for the new design, in Appendix O. Figure 36 and Figure 37 below show the full press design that will streamline the process by requiring minimal measuring and removing many of the subjective observations that had to be made when using the original press.

Figure 36: Isometric view of new press design

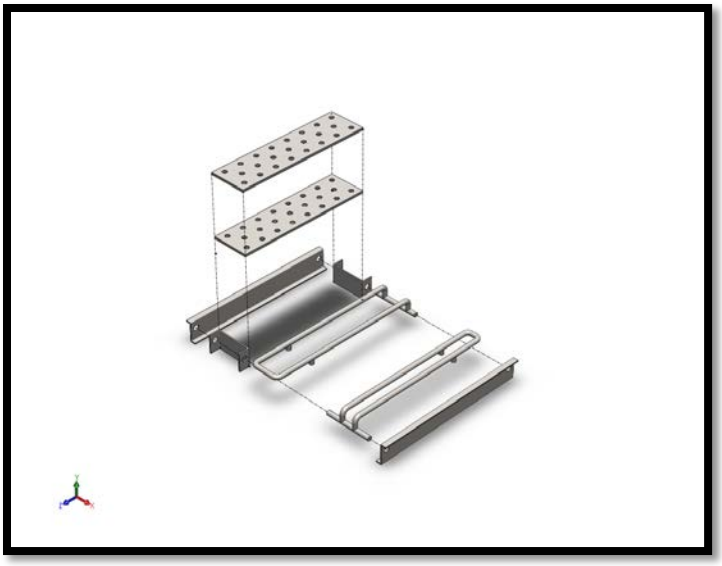

Figure 37: Exploded view of new press design

Because the cost of a new mold is significant, about N$600, we suggest that MSR only look towards producing new molds after the project has gotten off the ground. The old molds are capable of allowing MSR members to produce the blocks. However, if an MSR member wants to make a press on his own, we suggest that MSR allows him to use the designs and make any modifications he feels necessary.

We recommend the current supply of blocks be repurposed and remolded into the new design

The 2000 remaining blocks that were made in the past should be recycled and remolded into the new physical design. In addition to using new material, small portions of the current supply of blocks should be broken apart and mixed into the mixture and left to soak. While there will be no way of knowing what the composition of the blocks is, it is important that MSR makes sure that a variety of block mixtures are used. When filling 200L drums with sawdust and paper, it is a good idea to mix in five to ten old blocks so as to work through the supply without compromising the burn qualities of the newly designed mixture. Furthermore, it is necessary to manually break down the blocks into small pieces so that the materials can be adequately soaked and the paper can return to the pulp-like state required to mold the blocks. The speed at which the old blocks are being used up will be relatively slow, but should effectively make use of the blocks from the project when it was earlier in development.

We believe that these recommendations in combination with the new and improved block design can take the paper block project to a reality within the communities of Katutura. By taking these next steps we hope that the project will begin to sustain itself with minimal input from MSR. These recommendations are designed to maximize the potential of the product and we believe they are necessary for the product to gain a successful foundation within the informal settlements.

6 Conclusion

Our team spent a lot of time trying to get a sense of how people in the informal settlements of Katutura used firewood in their daily lives. We learned that the majority of people had little alternative to cooking outside over a wood fire. We also learned that people are traveling further and searching longer to find their firewood. Those who do not gather their own wood purchase it from local vendors whose prices have increased as their availability has decreased over the past decade. The idea of a viable alternative to firewood created excitement in the communities that we hoped to translate into future sales opportunities for MSR members.

We found, based on our interviews with pilot families and our own testing results, that the early design of the paper blocks was not suitable for cooking and did not meet the expectations of local residents. While the block worked well as a fire starter, it produced a weak, fickle flame that could not be used to cook, and produced too much smoke and ash. To address these problems, our team has successfully developed a new design for the paper blocks which features two parallel holes running lengthwise through the center of the block. The block is also thinner and less compressed than the original design. With this new design, the block produces more heat and burns hotter due to the increase of the surface area to volume ratio and the increase in airflow through the block. More importantly, a block with the new physical design and a composition of two parts paper and one part sawdust performs comparably to firewood.

As a major part of our project, we made sure that MSR members and community members could claim ownership of the project and its results. To do this, we involved MSR members and local residents in every step of our work. We talked with local residents and asked for their opinions on how we could improve the blocks and how we could to set up an effective business in the community. We had MSR members and local residents help us make blocks for our testing. We took their suggestions seriously in the development of a better paper block. In addition, we invited MSR members and several pilot families to a meeting where we provided a detailed description of the project and proposed business model. We then asked for their feedback on the scenarios of our business plan and provided answers to any questions that people had. We were able to generate interest from the members and had eight people sign up for future production.

At the end of our project, we organized a demonstration with MSR members on how to manufacture the paper block. Our team, together with John and Tessa, demonstrated techniques used to make the blocks. We also helped members practice the steps. Furthermore, we created an instruction manual and video of how to make the paper block to assist MSR with training members in the future. Finally, we identified three businesses located in Havana who showed interest in selling the paper block. We hope that the product will have a successful introduction into the communities.

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Appendix A: Interview Questions to Determine Current Cooking Methods

- What are some of the common meals you might make during the day?
- How many people do you make meals for?
- How do you cook those meals?
- How long does it take to cook a typical meal?
- What types of fuel do you use to cook with?
- How much does that fuel cost and how do you get it?
- How long does your fuel last?
- What is the accessibility of the fuel?
- What do you do if you can't get it?
- If you have to go collect firewood, where do you go to get it and how long does it take?
- Do you ever share firewood with your neighbors?
- Do you ever feel that you have to compete with your neighbors for wood?

Appendix B: Interview Questions for Pilot Testing Homes to Assess the Public Perception of the Block

- How long have you been using the blocks?
- How many times have you used the blocks?
- What are your primary fuel sources before or alongside the paper block trial period?
- Can you describe your experience using the paper block compared to your regular fuel sources? How much fuel do you use when you use the paper block as compared to when you do not use the paper block?
- In what ways are you satisfied with the paper blocks' performance?
- In what ways are you unsatisfied with the paper blocks' performance?
- How have your opinions of the paper blocks changed since the beginning of the trial? And why have they changed?
- Do you know many people who use the blocks?
- What do you believe is the main reason that people are not buying the blocks on a daily basis?
- Would you consider using the blocks on a more frequent basis after assisting with this trial period? Why or why not?
- What potential do you believe the block has as a regular fuel source in Katutura?
- Do you see any value in the block?
- [Assuming a positive outlook towards the block] What would you expect is the value of the paper blocks?
- How do you envision yourself using the block (fire starter, augment to firewood, replacement for firewood, etc.)?
- Do you think members of your community would be interested in purchasing the block?

Appendix C: Product Specifications for Cen-Tech Infrared Thermometer used in quantitative testing

Operating Instructions

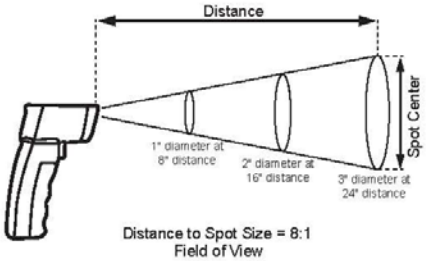
Read the ENTIRE IMPORTANT SAFETY INFORMATION section at the beginning of this manual including all text under subheadings therein before set up or use of this product.

General Operating Instructions

Note: Do not expose this product to strong electromagnetic fields, such as those generated by an arc welder, induction heater, etc.

Note: When moving the Thermometer to an area with significantly different ambient temperature, allow the unit to adjust to the new ambient temperature for 30 minutes before use.

1. Squeeze the Trigger to activate the Laser and temperature reading.
2. Push the °F/°C button to toggle between Fahrenheit to Celsius, and to recover the last reading when in OFF mode.
3. Squeeze the Trigger and move the laser to see a constant temperature reading and max reading.
4. Release the Trigger to display the most recent temperature reading, or to allow 15 seconds for auto shut off.
5. Non-reflective surfaces will yield a more accurate reading than reflective surfaces. Duct tape (sold separately) can be applied to reflective surfaces in order to get a better measurement. Allow sufficient time for the tape to match the temperature of the surface it is applied to before trying to get a reading.
6. The object being tested should be larger than the size calculated by the Field of View diagram, below.



Distance to Spot Size = 8:1
Field of View

7. When finished, release the Trigger. The last temperature will display for 15 seconds, then the unit will shut off.
8. Clean the lens with dry compressed air and wipe the rest of the unit down with a soft, damp cloth, then store the product indoors out of children's reach.
9. To prevent accidents, turn off the tool and disconnect its power supply after use. Clean, then store the tool indoors out of children's reach.

SAFETY
SETUP
OPERATION
MAINTENANCE

Item 69465 **For technical questions, please call 1-800-444-3353.** Page 5

Appendix D: Interview Questions for Local Businesses to Understand How They Share Information Through Social Networks

- What do you do to publicize your business in the community?
- What mediums have you found to be most effective (radio, leaflets, etc.)?
- How significant is word of mouth advertising to your business?
- When did you get the idea to start/run your business?
- What were some of the challenges you faced when you took the role of a business owner?
- How did you first let people know you were running a business?
- What has been your most successful method of advertising?
- Where do you get your advertising materials?

Appendix E: Interview Questions for General Public to Understand the Effect of Advertising

- How do you hear about new products most often?
- What types of advertising have influenced you?
- What makes you desire to purchase products?
- How much does radio or newspaper advertising influence your purchasing habits?
- How often do friends of yours tell you about products and/or businesses?

Appendix F: Interview Questions for MSR Employees to Assess the Current Marketing Plan for the Paper Block

- How long have you worked for MSR?
- How often has MSR sold paper blocks to individuals in the community?
- What are some of the reasons people will buy the paper blocks?
- What do you think are the block's biggest strength?
- What do you believe are the blocks' biggest weakness?
- Do you advertise the blocks around the community at all? If so, in what ways do you advertise the blocks around the community?
- What are the most successful forms of advertising used by MSR for the paper block?

Appendix G: Interview questions asked to Pius Shambabi

- Why did the project expand to include an insulation product?
- How long did you serve as the coordinator for the Paper Block Project?
- What was your marketing strategy for the paper blocks?
- How many days per week did you spend selling the blocks in the community?
- How many block could you sell in a day?
- What was the general mixture for the blocks when they were being manufactured?
- What was the biggest hindrance to the project's growth?
- How many MSR members were selling the blocks?
- What suggestions do you have for improving community awareness of the blocks?
- How has the insulation that was installed in your home last year performed?

Appendix H: Observations from Qualitative Tests

Table 1: Notes of qualitative test of original design made from sawdust in stove

Initial Test: Office Paper with Little to No Sawdust in Stove	
time	observation
18:30	increased heat output
22:30	small flames noticed on the block
25:00	additional heat output recorded
27:42	flame noticed on block
33:30	fire extinguished

Table 2: Notes of qualitative test of original design made from newspaper and sawdust in stove

Second Test: Sawdust with Newspaper in Stove	
time	observation
2:15	Blocks starting to ignite - orange flame
2:30	Smothered with large piece of newspaper
3:20	fire restored after much fanning
4:00	Very hot
5:30	smoldering, not lit
7:13	first third of brick ignited. Flame weak but steady
8:15	hotter still
8:45	all bricks ignited
9:25	covered pot with water placed on top of stove
10:45	flame out, block smoldering
11:15	after prodding with stick, flame returns
13:30	fanning released significant amount of ash out top of stove
16:50	pot of water removed - water quite hot to the touch and steaming
17:00	flame out, block smoldering
22:40	after prodding with stick, flame returns
25:30	fire extinguished

Table 3: Notes of qualitative test of original design made from office paper and sawdust in stove

Third Test: Office Paper with Sawdust in Stove	
time	observation
1:10	first blocks caught fire
1:50	green flame
2:22	exterior of block charred quickly
3:17	VERY hot
3:50	third of block out, smoldering
4:10	flame out, block smoldering
6:30	signs of life
7:15	heat lessened - comparable to first block
8:55	poked flame back to life
11:10	flames return, lots of heat
13:00	flames steady, no tending required
18:50	flames gone, large chunks of block remain
19:20	smolders remain flame is not coming back
20:30	significant drop in heat output
21:45	flame coaxed back to life with a lot of effort
22:30	VERY hot
26:45	flames out, block smoldering
32:50	fire extinguished

Table 4: Notes of qualitative test of original design made from newspaper and sawdust in open air

Fourth Test: Open air newspaper with sawdust	
time	observation
2:15	flames on block
3:30	significant heat output
4:00	smoldering with no flame
5:15	fanning produces fire
6:55	adding more newspaper causes flames to arrive then immediately vanish
7:40	flames return
11:00	constant fanning keeps fire going
12:15	strong flames
12:45	smoulders
13:40	fanning brings back flames
16:00	constant fanning keeps fire going
17:15	prodding smoulders
18:05	fanning revives fire
22:05	lots of smoulders
26:00	dead fire (flames gone)
28:00	flames sporadic with wind
31:00	smoulders only
34:40	fire extinguished

Table 5: Notes of qualitative test of original design made from office paper with no sawdust in open air

Fifth Test: open air office paper with no sawdust	
time	observation
0:15	lots of smoke
0:50	one third of blocks burning
2:20	Green flames
3:13	fanning yields lots of flames
3:25	it's hot!
6:40	block is smoking, no flames; burning newspaper added
7:55	block sort of burning
10:08	more fanning decent flame
11:10	flame out
12:06	flame is back
13:40	flame out
16:40	newspaper and fanning results in brief visible flames
17:20	consistent flames
19:15	smoulders
20:23	lots of fanning causes flames to return
23:45	flame out -> smoulders
36:45	fire extinguished

Table 6: Notes of qualitative test of original design made from repurposed materials

Recycled old block, thick	
time	observations
1:00	newspaper and block blackened
1:25	block is lit
2:20	fanning causes flames, but they immediately vanish
4:15	gray ash along edges of block
4:40	fanning causes more flames
6:17	still burning, with minimal flame
7:10	pulling ash off block helps burning
7:20	fanning causes flames, flames last 30 secs
9:30	pulling more ash off blocks
9:45	fanning causes flames, flames last 20 secs
11:45	fanning causes more flames
15:40	fanning causes more flames, flames last 15 secs
16:30	fanning causes more flames, flames last 10 secs
18:10	fanning causes no more flames, block is smoldering
27:40	dead fire
General observations	
lots of smoke, didn't see any real difference from original design	

Table 7: Notes of qualitative test of original design made from repurposed materials

recycled old block, thin	
time	observations
0:40	block is burning
1:40	block is smoldering, but very hot. Fair amount of smoke, but less than be fore
3:30	good consistent, visible flames
4:40	still flames, no tending
6:00	still flames, no tending
6:40	remove ash, flames remain
7:40	light fanning keeps flames going
8:50	dead fire
General observations	
easy to light	
easy to maintain	
lots of heat output	
very strong flames	

Table 8: Notes of qualitative test of original design made from new office paper

Office paper, new materials, thick	
time	observations
0:40	newspaper burning, but not block
1:20	block is burning with visible flames
2:30	flames are still visible
3:00	no visible flames
3:30	smolders
4:00	lots of smoke, no visible fire
5:05	fanning produces fire
6:50	flames go out
7:30	fanning produces fire
8:00	flames still going
11:30	flames remain, wind helps
13:15	flames remain, no tending
15:00	observe flames coming from ventilation holes
19:45	flame out, smoldering
20:20	fanning produces fire
21:45	fire dies

Table 9: Notes of qualitative test of new, thin design made from only office paper

Fresh office paper only, thin with holes, ~3.5cm	
time	observation
0:30	Block caught fire
2:00	Flame from newspaper died; flame by block was not as strong
8:20	"Serious heat"- Strauss
9:10	Flame out
9:20	Strauss fanned and fire back
13:31	Flame out
14:06	Flame out again, Block was left smoldered and die
14:55	Completely dead
Summary	Less smoke; easier to maintain flame than the newspaper ones (below); not a lot of smolder

Table 10: Notes of qualitative test of thick block with holes running through it made from newspaper and sawdust

Thick (5cm), fresh material, new design, newspaper and sawdust	
time	Observation:
0:07	Block caught fire
1:31	Flame from newspaper die; Flame from block was not as strong
7:00	Flame out; lots of smoke
7:50	Flame back with fanning; less smoky
13:17	Flame out
13:30	Flame back with fanning
13:57	Flame out
13:57 --> 15:00	Flame back and out
15:00	flame back with fanning
15:40	flame out
16:40	flame out
16:50	flame back
17:50	no flame; block was left smoldered
20:00	completely dead
Summary	Smolder more than the thin, office paper block; catch fire easier than the original design; smoke the most compared to the other two blocks tested on the same day.

Table 11: Notes of qualitative test of new design, made from newspaper and sawdust

Thin (3.5cm; but not as thin as the thin, office paper one), fresh material, new design, newspaper and sawdust	
time	Observation:
0:37	Block caught fire
1:27	Flame from newspaper died
3:13	Strong flame due to more surface was burning
5:30	Flame out; lots of smoke
6:00	flame back with scraping and fanning; strong flame
8:20	Flame die
8:35	Flame back
9:09	a very weak flame, lots of smoke
10:20	Flame die, even with scraping
10:37	Flame back
12:20	Flame out
12:37	Flame back with fanning
13:10	Flame out
13:21	Flame back with fanning
14:05	flame out; the block was left smoldered until it dies
17:04	Completely dead
Summary	Smolder more than the thin, office paper block; catch fire easier than the original design

Table 12: Notes of qualitative test of new design made with new materials

Sample: new design, new material	
time	observation
0:37	block is on fire
1:59	fire is out, lots of smoke
5:13	after lots of fanning and scraping fire returns. Significant heat output noted
10:30	fire is out, one piece of the block is burned out, ashes not breaking away from block
12:45	all pieces of the block are smoldering
15:45	dead fire

Table 13: Notes of qualitative test of new design with less compression

new design, less compressed	
time	observation
1:15	block is on fire, goes out after 15 seconds
3:25	fanning brings back fire
3:40	fire out, begin fanning
4:00	fire back
4:55	fire out, begin fanning
5:01	on again
5:52	fire out
6:24	flames return
6:35	flames gone
7:35	flames return
7:44	flames gone
12:00	after much fanning and scraping of ashes, the flames return
14:45	flames gone
15:05	flames return
16:07	flames out, smoldering
19:13	dead fire

Appendix I: How to Make Paper Blocks: A Step by Step Guide

What You Will Need

Equipment:

- 200L Drum

Figure 38: 200L drum

- 20L paint can

Figure 39: 20L Paint Can

- 10L bucket

Figure 40: 10L Bucket

- 29.2cm length by 8cm width by 5cm height paper block press with two marked lines

Figure 41: Press with arms folded

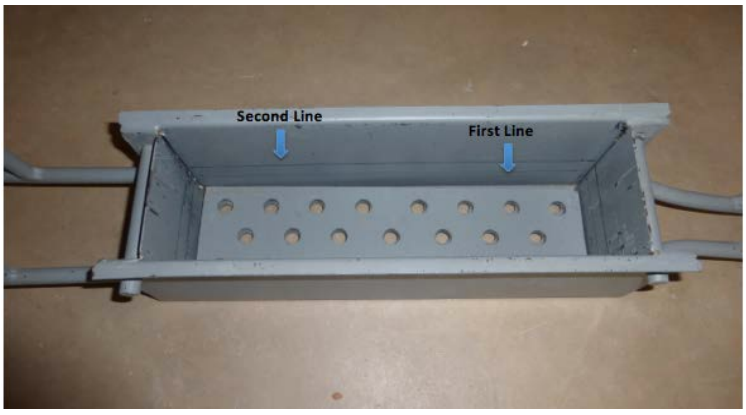


Figure 42: Press with arms open showing two fill lines

- iron rods 29.2cm long, 1cm in diameter (2 per press used)

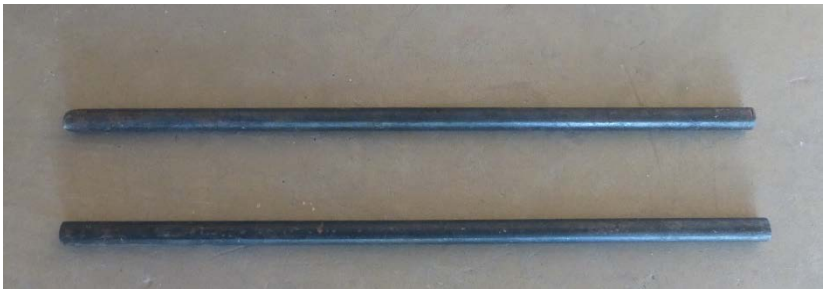


Figure 43: Rods for use in block

- 10 meter by 10 meter black Tarp or Drying Rack

Figure 44: Large black tarp for drying blocks

Figure 45: Drying rack for blocks

- Mixer: a long sturdy branch or stick
- Rubber Gloves

  Materials:
- Shredded paper
- Wood shavings/sawdust

Step 1: Add Shredded Paper and Wood Shavings/Sawdust in 2:1 Ratio Respectively to the Large Bucket

Using the 10L bucket loosely fit it with materials. Add materials to the large bucket. To make approximately 100 paper blocks, add 26 buckets of shredded paper and 13 buckets of wood shavings/sawdust.

Figure 46: Buckets of Shredded Paper and Wood Shavings/Sawdust in 2:1 Ratio

Step 2: Mix Materials

Using a mixer or your hands, mix the dry paper and sawdust until the mixture looks the same everywhere.

Step 3: Add Water

Add enough water to the mix so that the paper and wood shavings/sawdust are completely covered, or begin to float.

Figure 47: Mixture after soaking for 3-5 days and becoming pulpy

Step 4: Leave to Soak

Leave the mixture to soak for 3-4 days and stir at least once per day.

Step 5: Scoop Mixture from 200L Drum into the 20L Bucket

Step 6: Drain Excess Liquid from 20L Bucket

Use a plate from the paper block press as a filter to pour water out and the mixture in.

Figure 48: Removing excess water from mixture

Step 7: Put the Paper Block Press on Cinderblocks

Set 2 cinderblocks approximately 25cm apart. Place the press on the cinderblocks.

Figure 49: Empty mold on top of cinderblocks

Step 8: Add Mixture to First Line in the Press

Loosely pack in the mixture up to the first line in the paper block press. Try to make it as even as possible.

Figure 50: Mold filled to first line with mixture

Step 9: Place Rods on Top of Mix

Place two rods on top of the mixture in the paper block press. Try to space them evenly and align them parallel to the long side of the press.

Figure 51: Rods placed on top of mixture

Step 10: Add Mixture to Second Line in the Press

Loosely pack in mixture up to the second line in the paper block press. Ensure that the rods are completely covered and try to make it as even as possible.

Figure 52: Mold filled with mixture to second line

Step 11: Place the Top Plate of the Press on the Mixture

Figure 53: Placing the top plate on the mixture

Step 12: *Gently* Press the Plate with Your Hands

Only press until the second line is once again visible. Too much compression will make the finished blocks burn worse.

Figure 54: Compressing the mixture in the press

Step 13: Remove Top Plate

Figure 55: Mold filled with compressed material

Step 14: Transfer the Block to the Tarp or Drying Rack

Walk the press over to the tarp or drying rack. Very carefully flip the press over. Slide the block out of the press onto the tarp or drying rack.

Figure 56: Block being turned over to remove from mold

Figure 57: Pushing block out of mold

Step 15: Remove Rods from Block

Gently push on the exposed ends of the rods until you can grip the other side. Pull the rods straight out being careful not to damage the block.

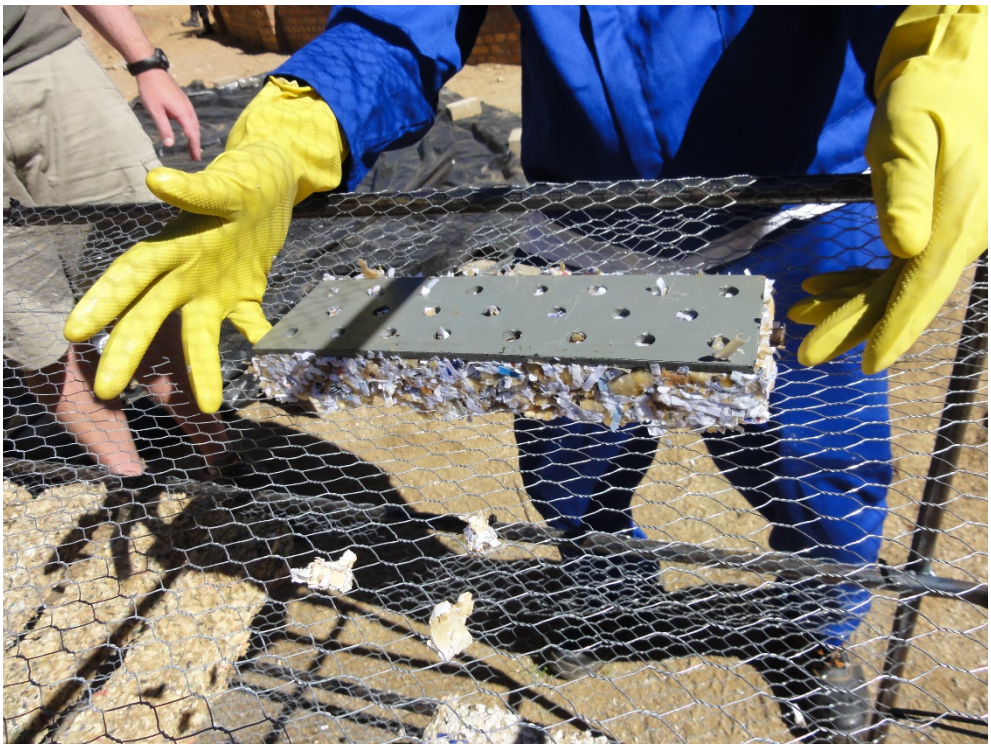


Figure 58: Pushing rods out of the block

Figure 59: Pulling rods out of block

Step 16: Remove Plate from Top of Block

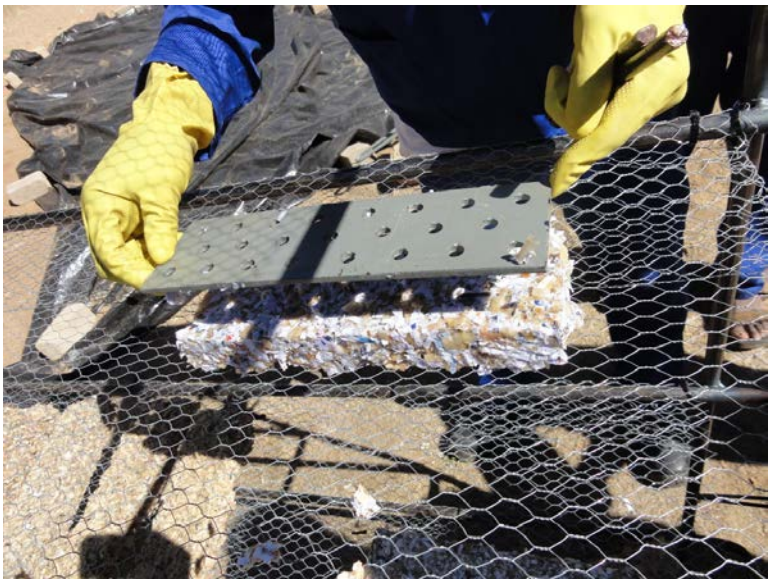


Figure 60: Removing top plate from newly molded block

Step 17: Allow Block to Dry Completely

This should take approximately 5 days during the sunny season. If it rains, either cover the blocks or bring the blocks inside if possible.

Figure 61: Completed block

Appendix J: Temperature Data from Quantitative Testing

Any graph with multiple lines represents a test that was performed more than once, with one line representing one test.

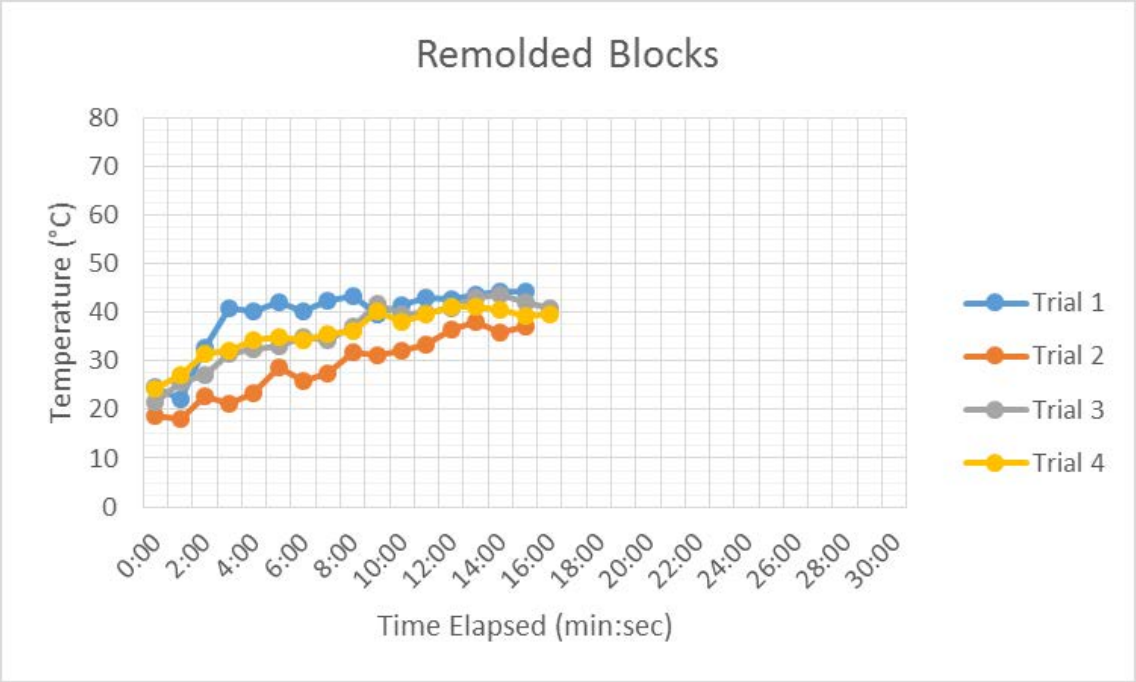


Figure 62: Graph showing results of testing the blocks made with the new design, using repurposed paper blocks

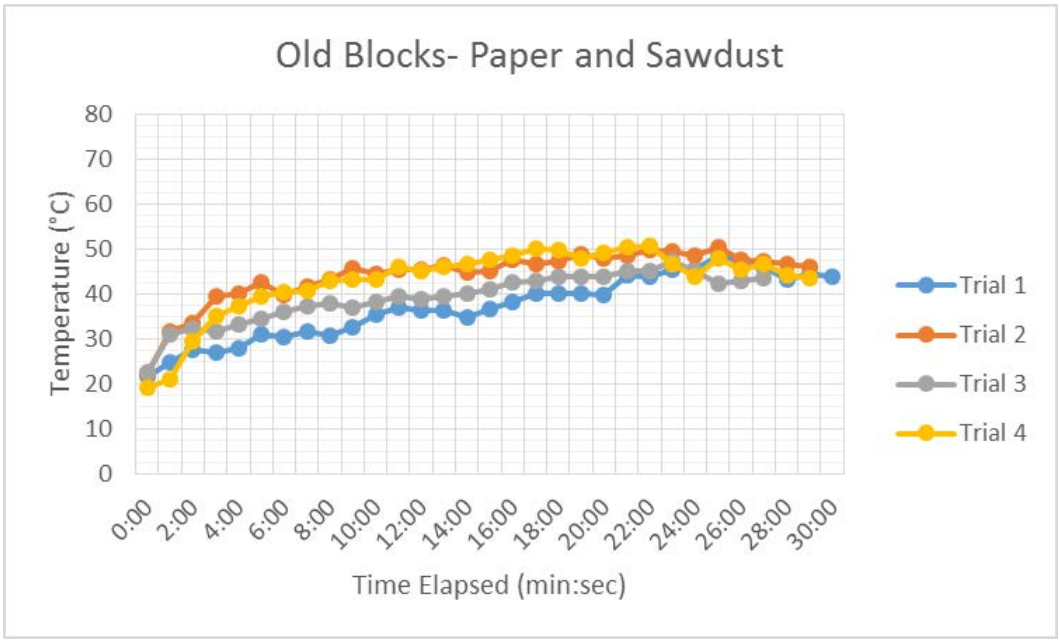


Figure 63: Graph showing results of testing the old paper blocks with sawdust and paper

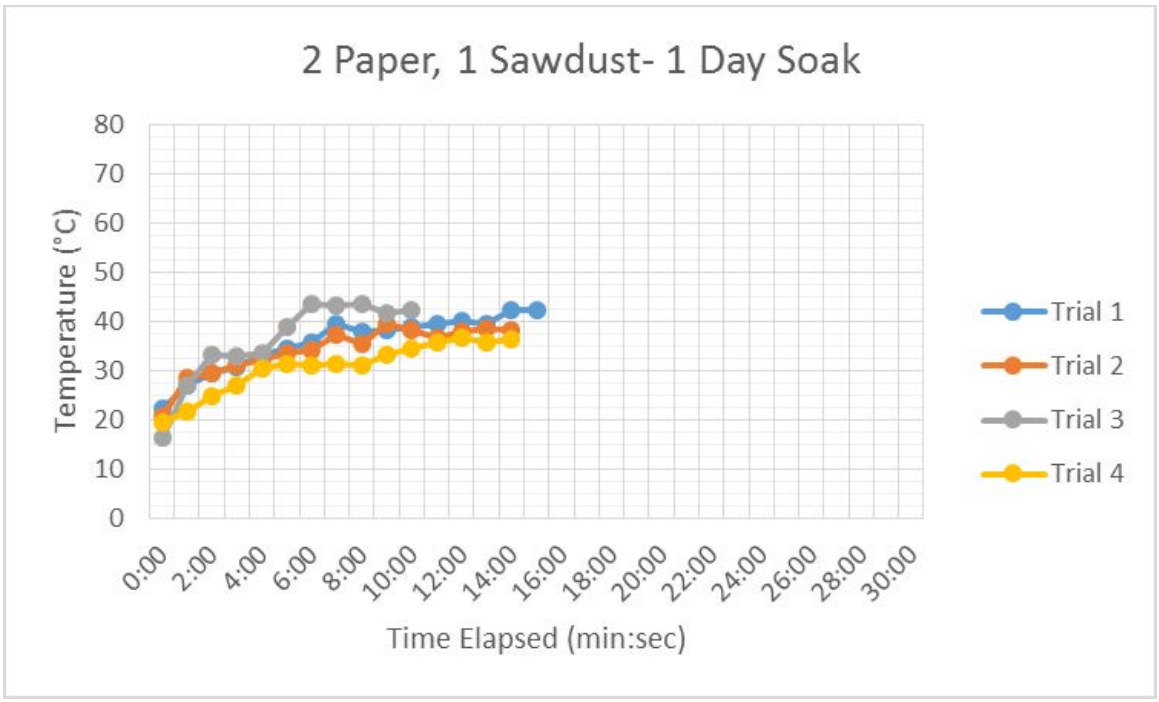


Figure 64: Graph showing results of testing the two parts paper, one part sawdust blocks that soaked for five days

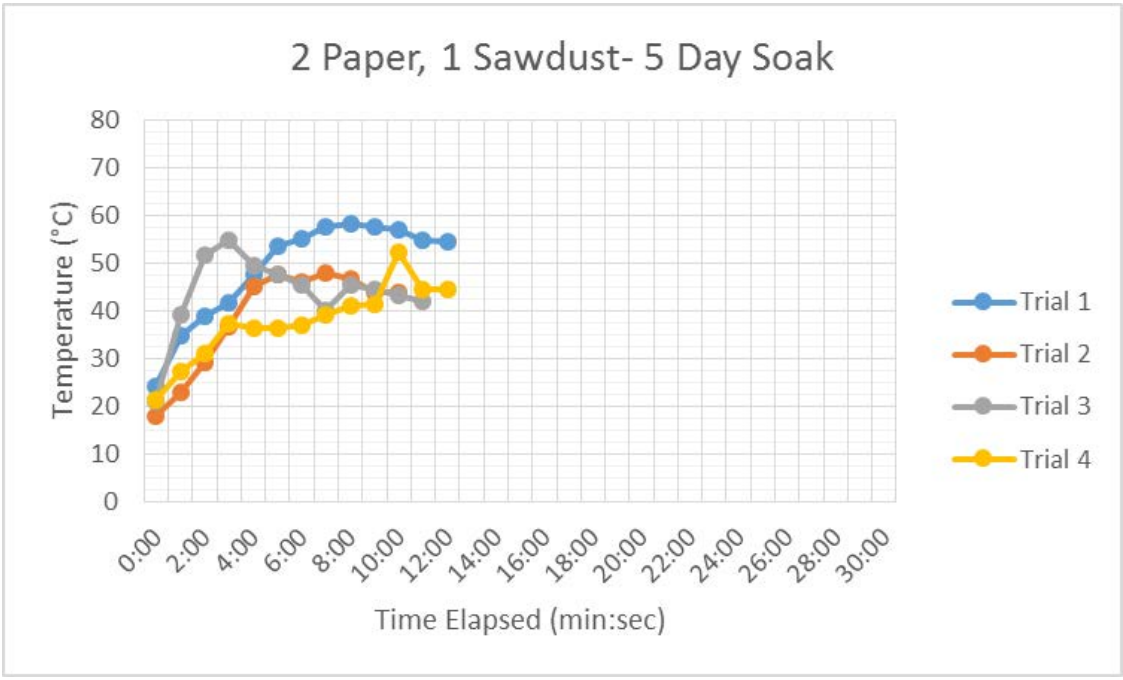


Figure 65: Graph showing results of testing the two parts paper, one part sawdustblocks that soaked for one day

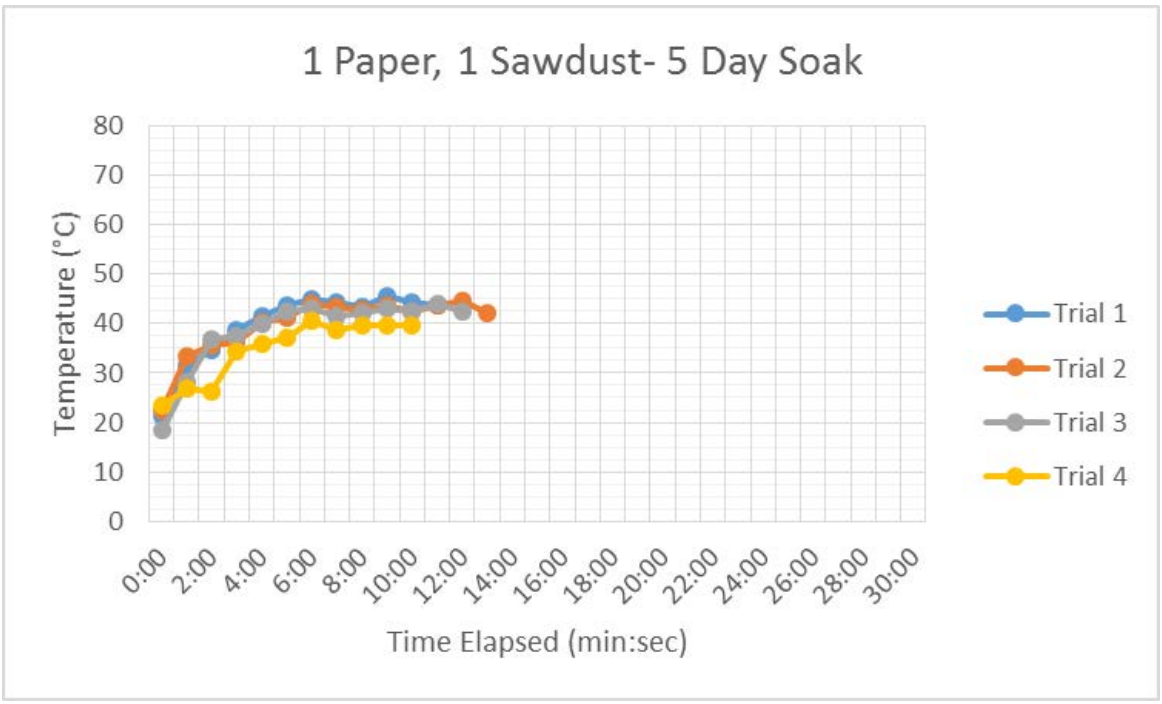


Figure 66: Graph showing results of testing the one part paper, one part sawdust blocks that soaked for five days

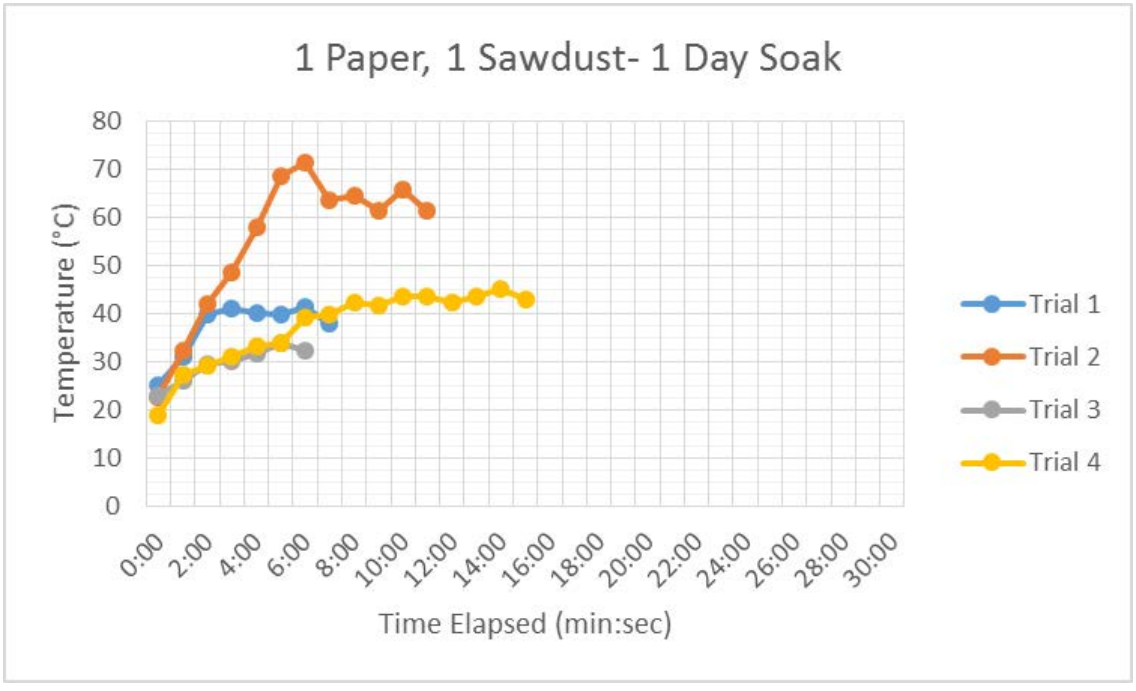


Figure 67: Graph showing results of testing the one part paper, one part sawdust blocks that soaked for one day

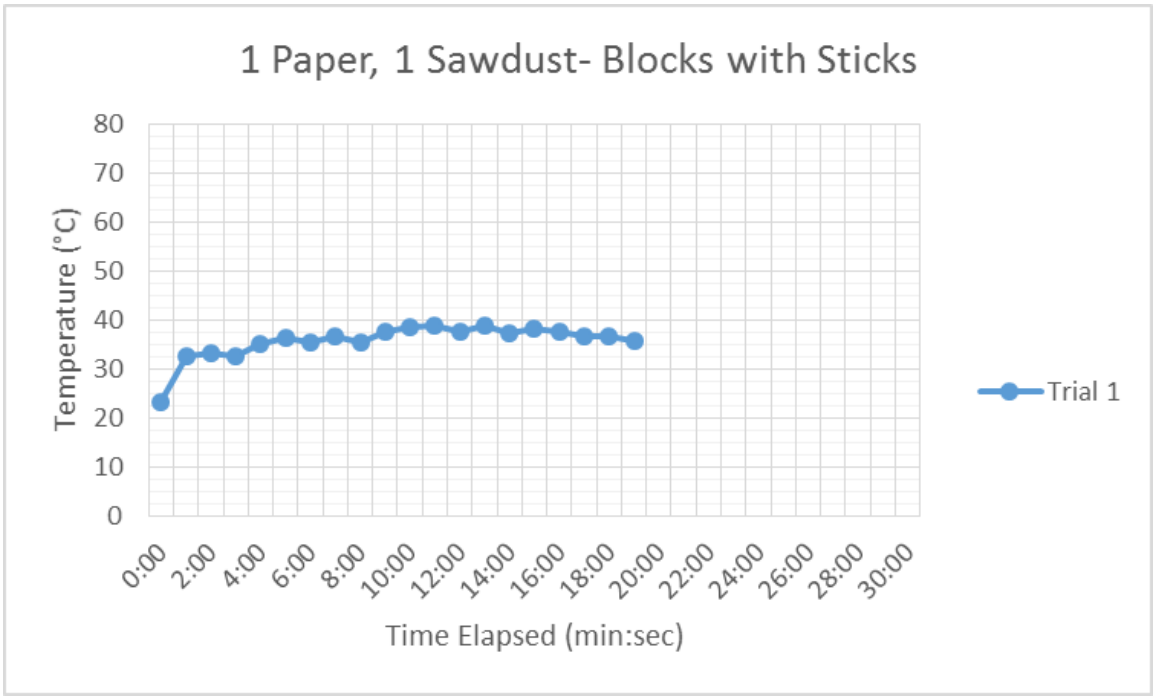


Figure 68: Graph showing results of testing the one part paper, one part sawdust block that soaked for five days with sticks placed inside

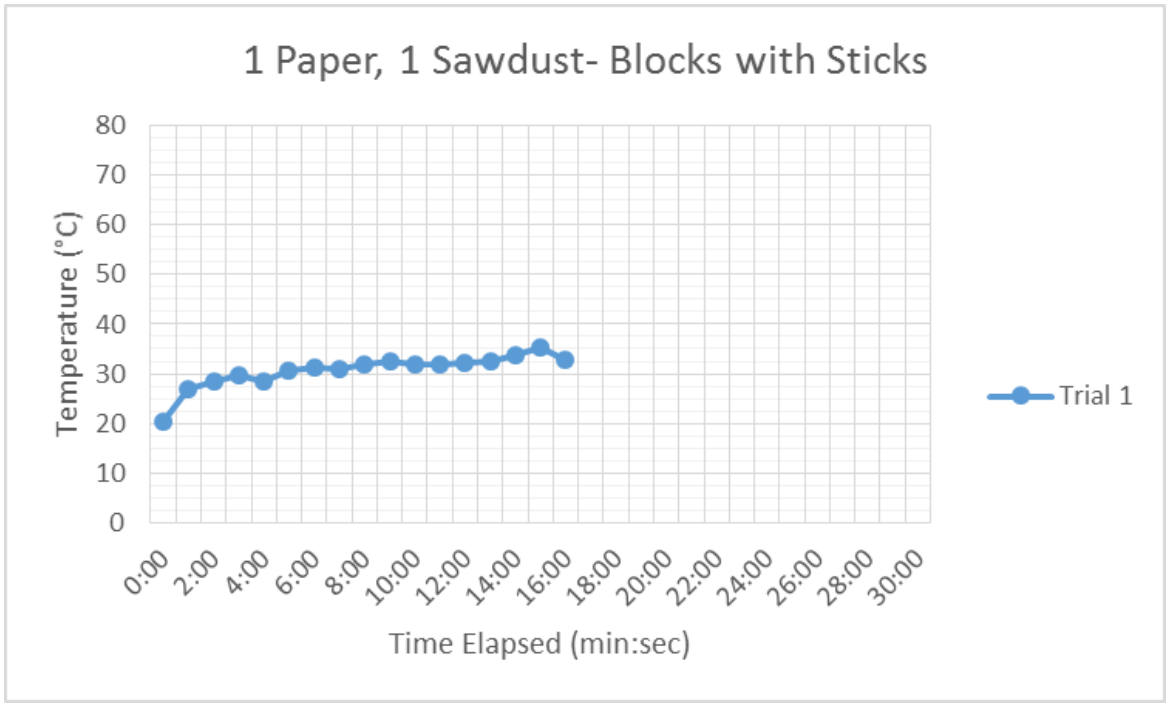


Figure 69: Graph showing results of testing the one part paper, one part sawdust block that soaked for five days with sticks placed inside

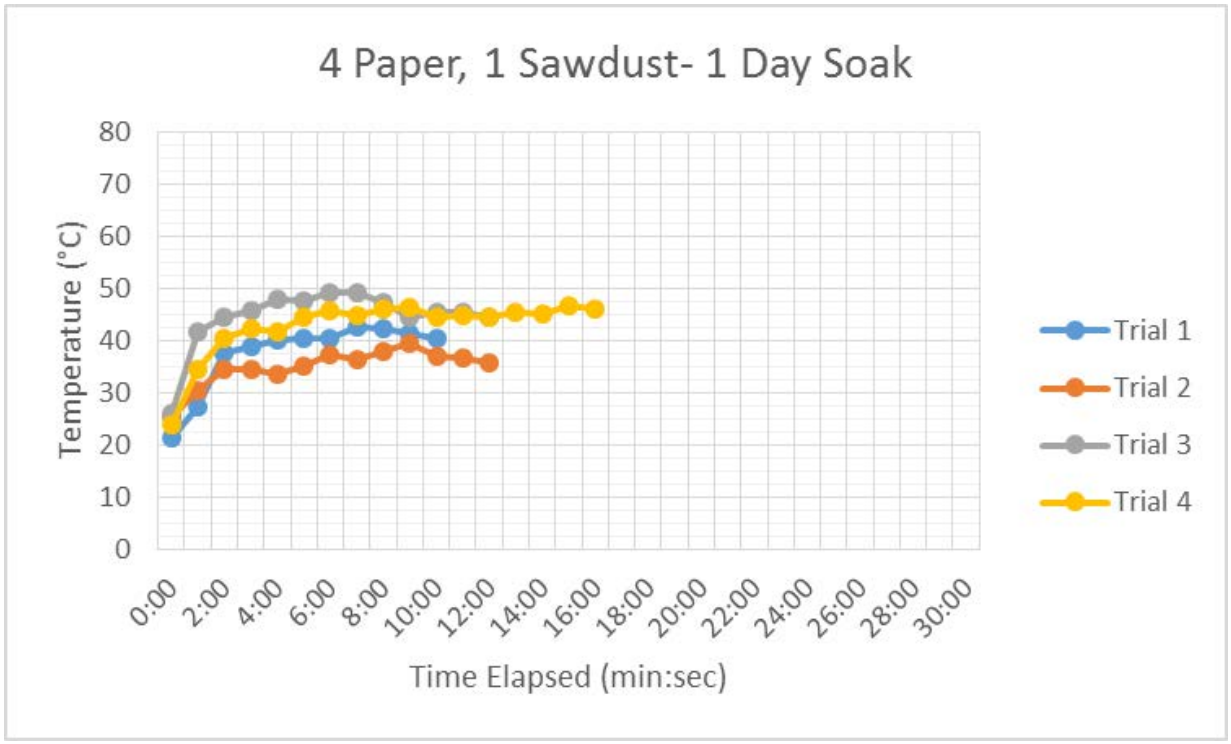


Figure 70: Graph showing results of testing the four parts paper, one part sawdust blocks that soaked for one day

Figure 71: Graph showing results of testing wood

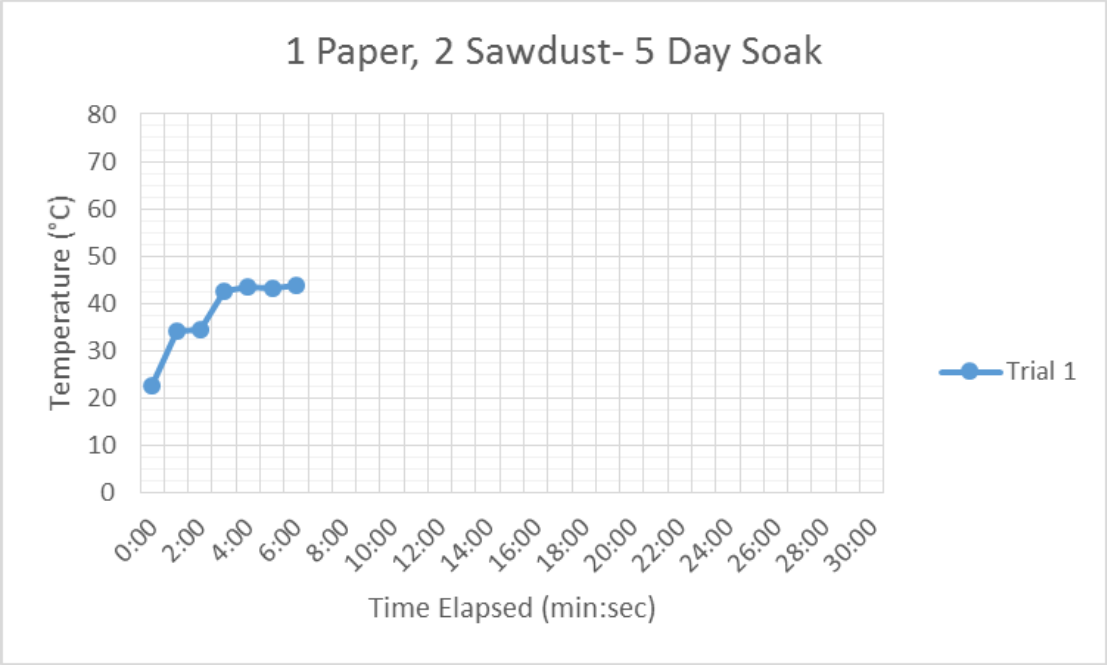


Figure 72: Graph showing results of testing the one part paper, two parts sawdust block that soaked for five days

Appendix K: Paper Block Project Coordinator Job Description

Men on the Side of the Road (MSR) is currently looking for an energetic, hardworking individual to serve as the coordinator for the paper block project. This project manufactures and sells firebricks as an alternative to firewood to residents of the informal settlements in Katutura. It is estimated that the selected individual will spend no more than 10 hours per week performing the roles and responsibilities described below.

Qualifications:

- Capable of maintaining accurate financial records
- Excellent oral communications skills
- Entrepreneurial minded – shows great initiative
- Outgoing personality
- Basic computer literacy
- English proficiency preferred

Responsibilities:

- Train MSR members to make the block properly
- Maintain lists of:
    - Retailers who have partnered with MSR
    - Local individuals who have been trained to make the blocks
- Manage orders for blocks from retailers and organize members to produce blocks to fill orders
- Track payment to MSR for overhead
- Track project expenditures including the purchase of gloves, overalls, molds, drums, etc.
- Maintain shared equipment such as molds, drums, gloves, etc. and obtain replacements as necessary
- Track performance quality of blocks manufactured by MSR members through periodic testing of blocks
- Grow the project over time through:
    - Expansion of production capacity when necessary
    - Identifying new retailers

- Maintain positive relationship with community leaders and community councilors
- Continue to develop and refine the ideal paper block mixture are per feedback from retailers and customers

Appendix L: Proposed Business Model for the Paper Block Project

General understandings:

- MSR members' expectations: In general, MSR members earn approximately $100/day when doing day labor.
- The block is sold to retailers at $1.00 with $.10 going to MSR for overhead.
- MSR does not cover any transportation fees for members other than block delivery as described in Case 1a.
- All communication between retailers that are identified by MSR and those who manufacture the blocks is made through the Paper Block Project coordinator (Ordering, etc.).
- MSR members can store the blocks at the office.
- Retailers who partner with MSR get a laminated A3 sign for free.
- Retailers are free to set the final selling price of the block for their customers.

Case 1:

- MSR members come to the MSR office to make the paper blocks and then sell them to retailers that are identified by MSR.
    - At the beginning (the first 200 blocks):
        - Members receive N$0.40 for every block they make from MSR.
        - Members will deliver and sell blocks to retailers for N$1.00/block. (MSR will be covered the delivery cost i.e. round trip taxi fare between MSR and the retailer)
        - Members bring back N$0.50 for every block to MSR and take the remaining N$0.50.
        - In the end, members earn N$0.90/block for manufacturing and delivering the blocks.
    - Long term:
        - **Retailers come to MSR to pick up the blocks** and pay N$1.00/block. MSR receives N$0.10/block and MSR members receive N$0.90/block.

- Retailers are free to set the final price of the block.

Case 2:

- MSR members come the MSR office to make the paper blocks and bring them home to sell to either retailers (that they find themselves) or consumers.
    - MSR members make blocks, receiving no payment from MSR at the time of production.
    - Members pay N$0.10 for every block they take home.
    - Members sell the blocks at a recommended price of N$1.00 or at whatever price they decide.
    - This scenario will likely apply to MSR members who believe that they can sell large numbers of blocks at their own shop for more than N$1 per block.

Case 3:

- MSR members take the mold and make blocks at their home. They then sell the blocks to either retailers that they find themselves or consumers at a recommended price of N$1.00 or at whatever price they decide.
    - MSR members will need to contact MSR in advance to get the materials (paper and sawdust).
    - Ideally, MSR members pay approximately N$600 to MSR to buy the equipment including molds, metal rods, strings (for packaging), oil drums, etc. except for paper and sawdust all at once.
    - Alternatively, they can also make a deposit of N$200-N$300 (this number is negotiable at the discretion of MSR) for the equipment they bring home. After they are finished using the equipment, they can return it to MSR and get refunded.
    - In addition, they would have to arrange to come to the MSR office and buy the paper and sawdust from MSR at a price that covers the MSR costs for transportation of the raw materials to MSR.

Case 4:

- MSR members just want to sell the blocks
    - MSR members are treated as a retailer from MSR's perspective.
    - MSR members come to the office and buy blocks for N$1.00 per block.
    - MSR members are free to set their own final retail price

Case 5:

- People who are not MSR members but are interested in making the paper blocks are welcomed to do so. They will be treated equally to MSR members, but they are required to make the blocks at the MSR office at first. They are equally entitled to the benefits described in Cases 1a and 1b
    - After they come in and make the blocks several times and show commitment and enthusiasm, they will be allowed to take the equipment and produce the blocks at their homes if they wish, but make a financial investment similar to what is described in Case 2.

Appendix M: Graphic Representation of Business Model as Presented to the MSR Members on April 29

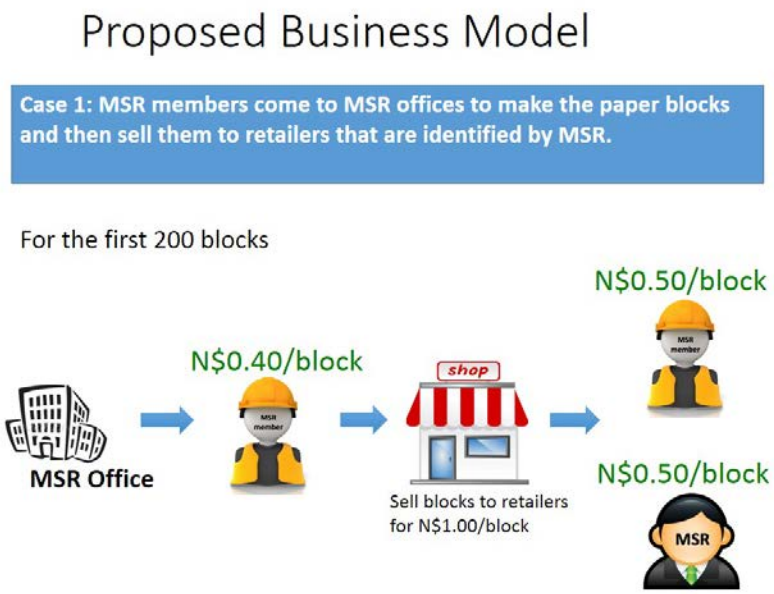


Figure 73: Introductory period of first scenario of proposed business model

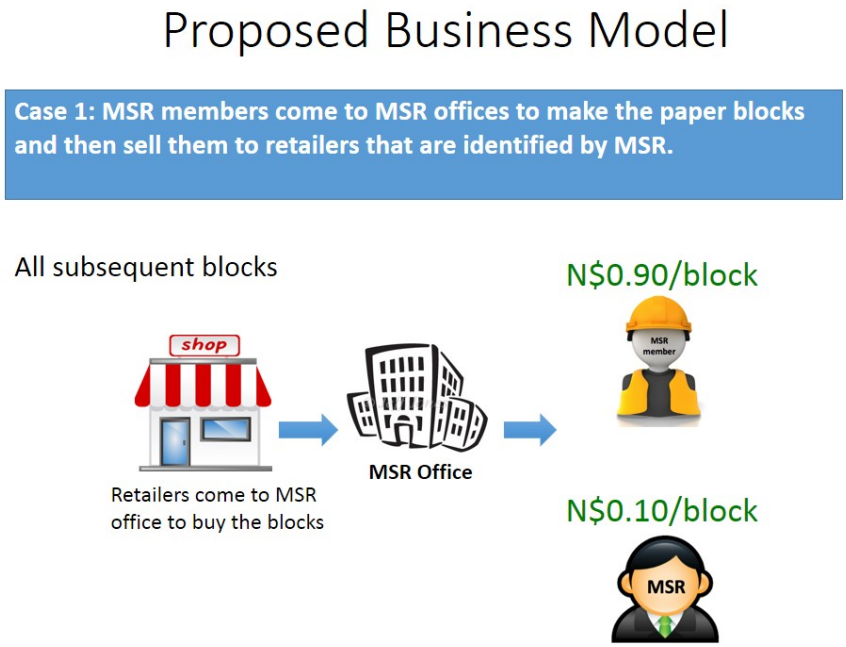


Figure 74: First scenario of proposed business model after introductory period

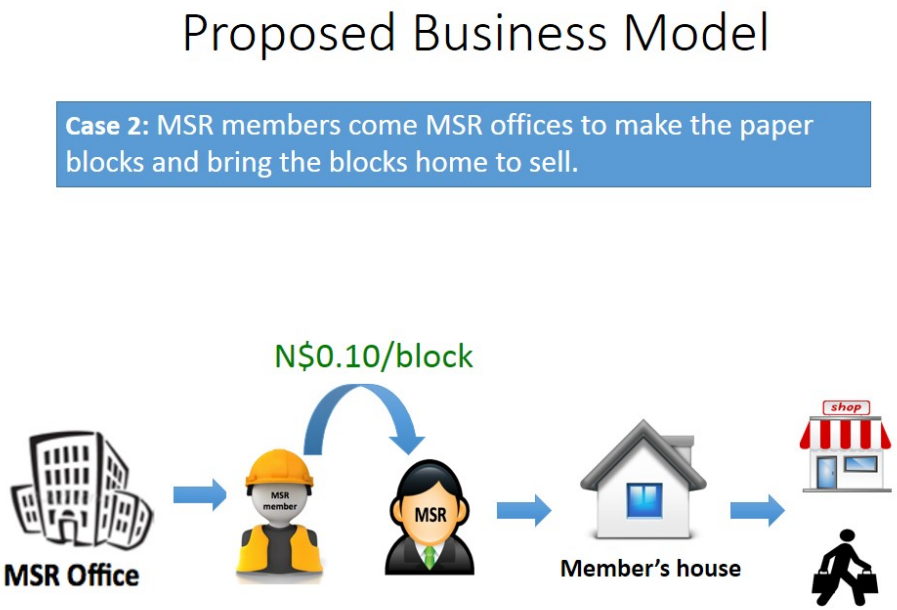


Figure 75: Second scenario of proposed business models showing how MSR members can sell block at their homes

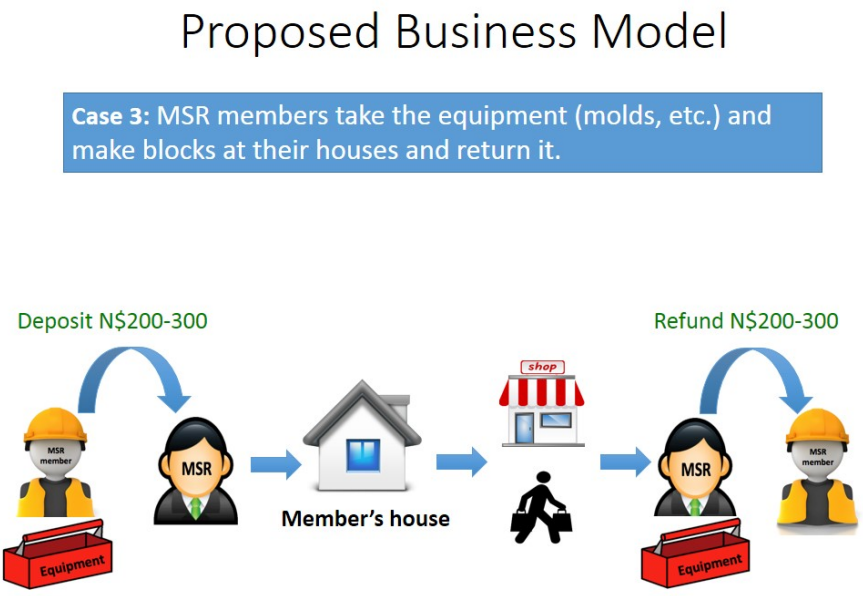


Figure 76: Third scenario of proposed business model showing how MSR members can rent the production equipment from MSR.

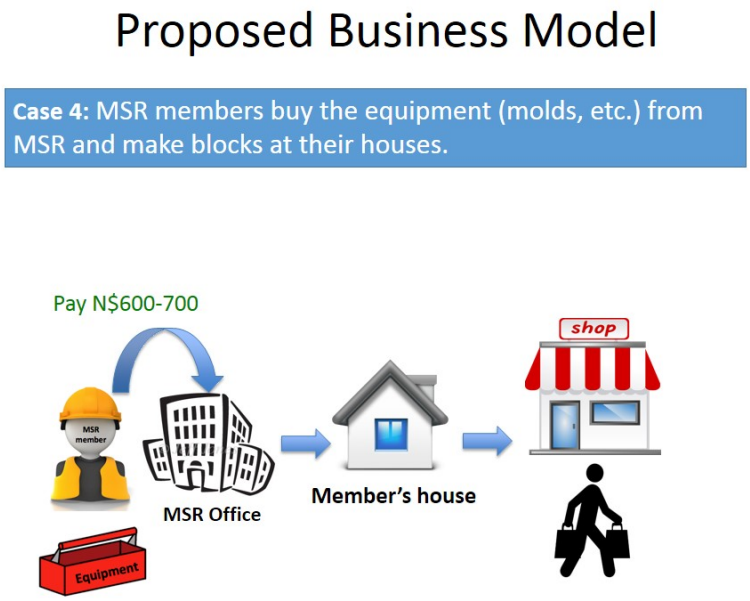


Figure 77: Fourth scenario of proposed business model showing how MSR members can own the production equipment

Appendix N: Sample Sign to Give Retailers Who Partner with MSR

The text on this sign will be in both Oshiwambo and English. The green text will be Oshiwambo and the purple text will be in English. There will also be a place for the shop owner to write in their cell phone number.

Appendix O: Design for a Press Optimized for Producing the New Blocks

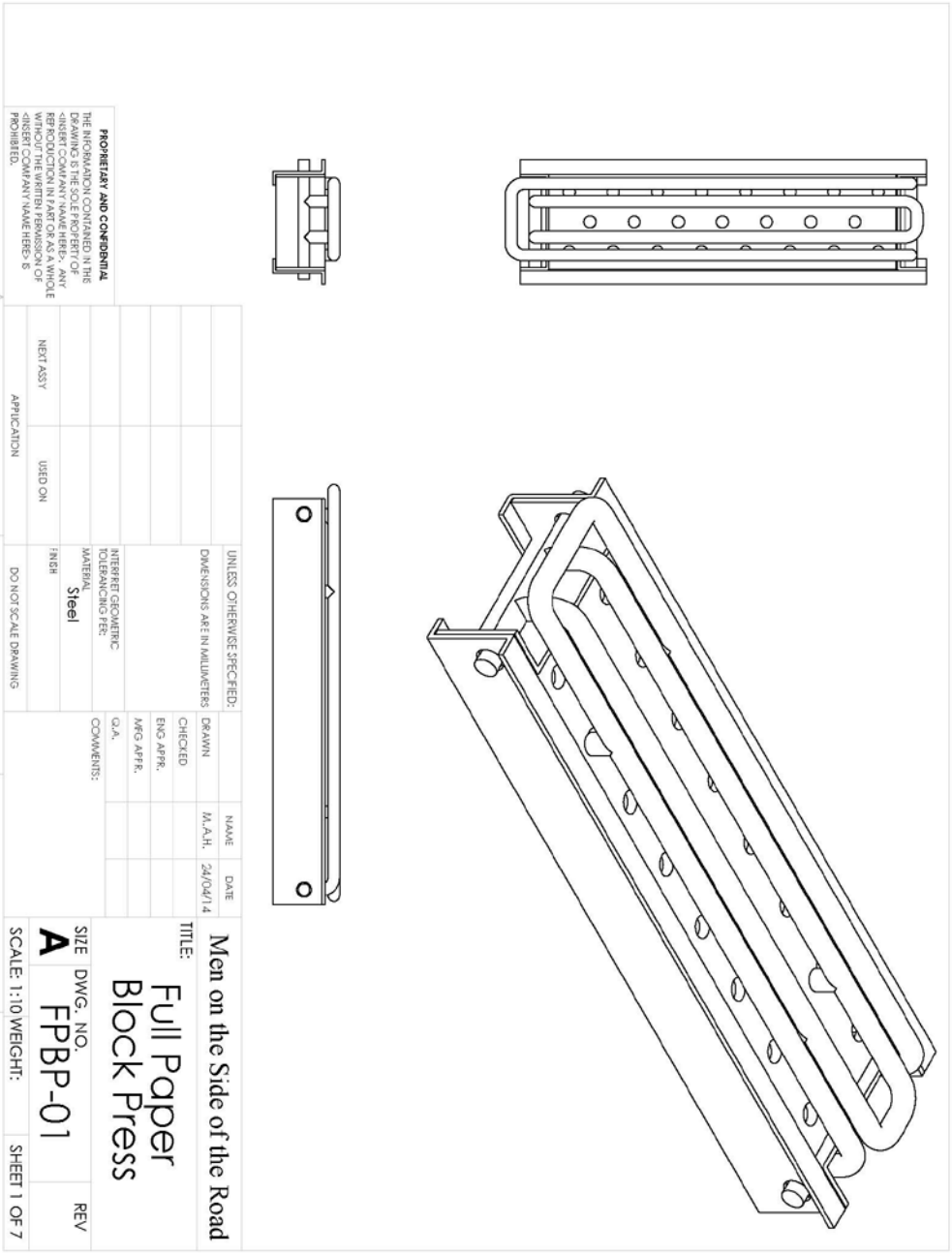


Figure 78: Isometric views of new press design

Figure 79: Exploded view of new press design

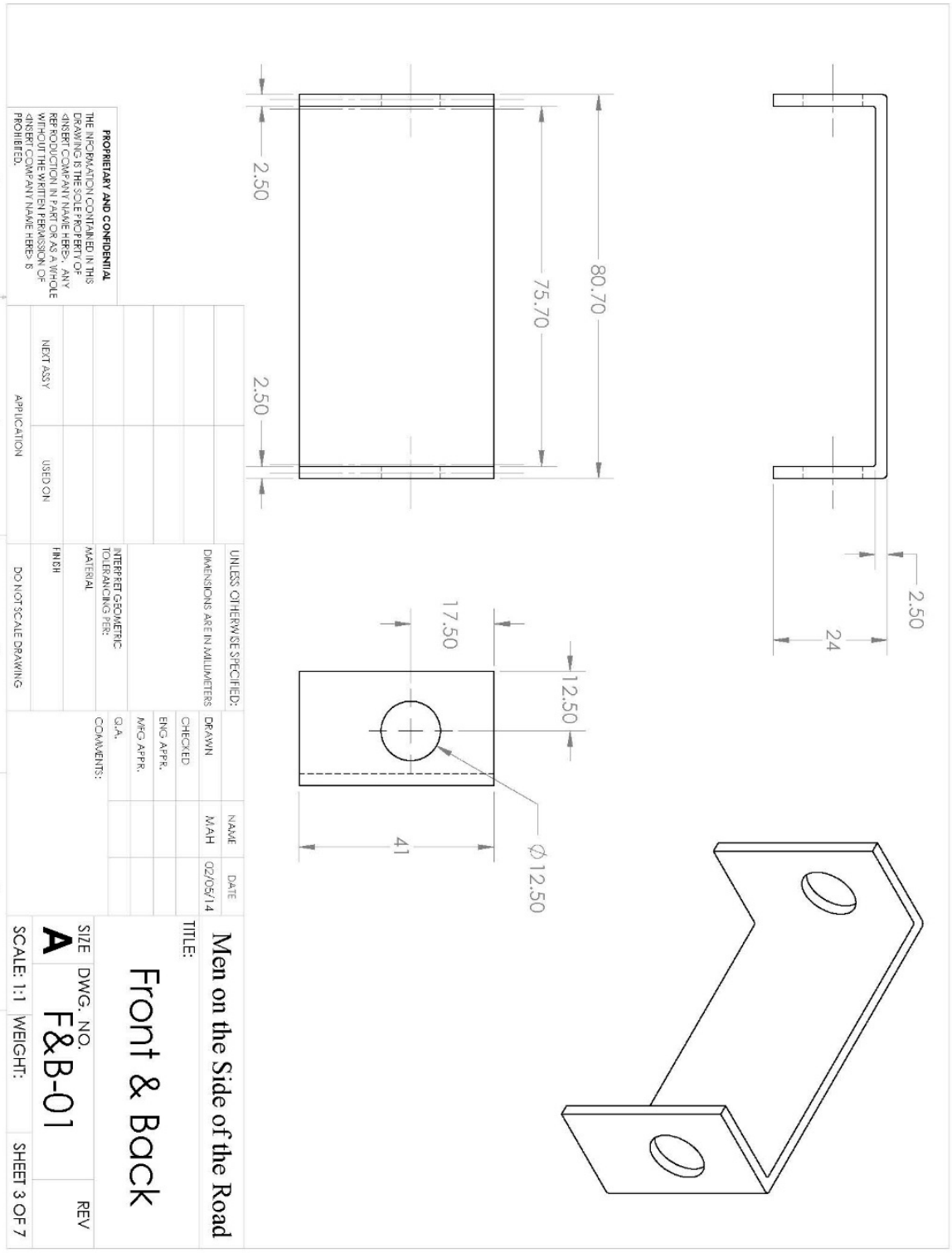


Figure 80: New design of front and back plates

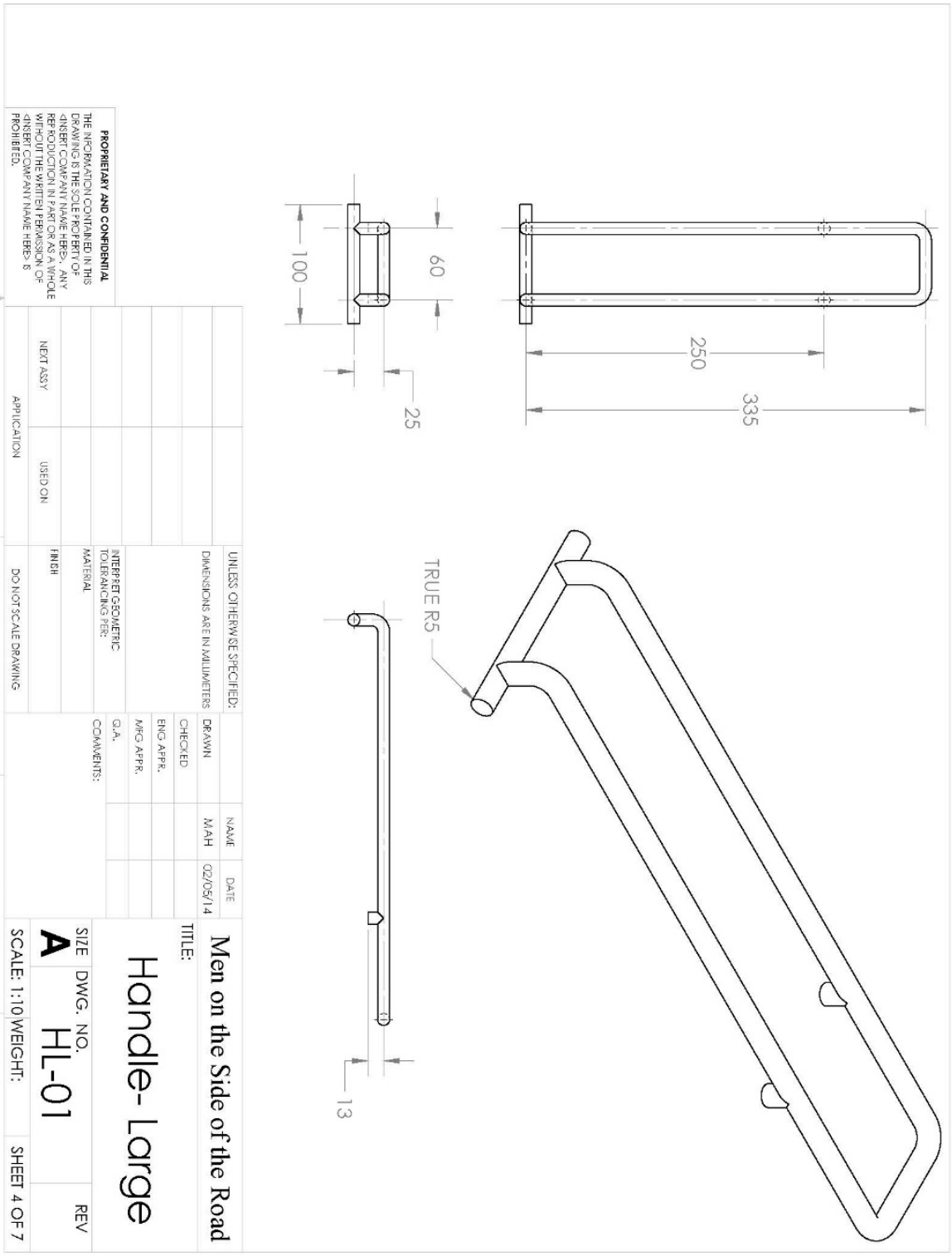


Figure 81: New design of large handle

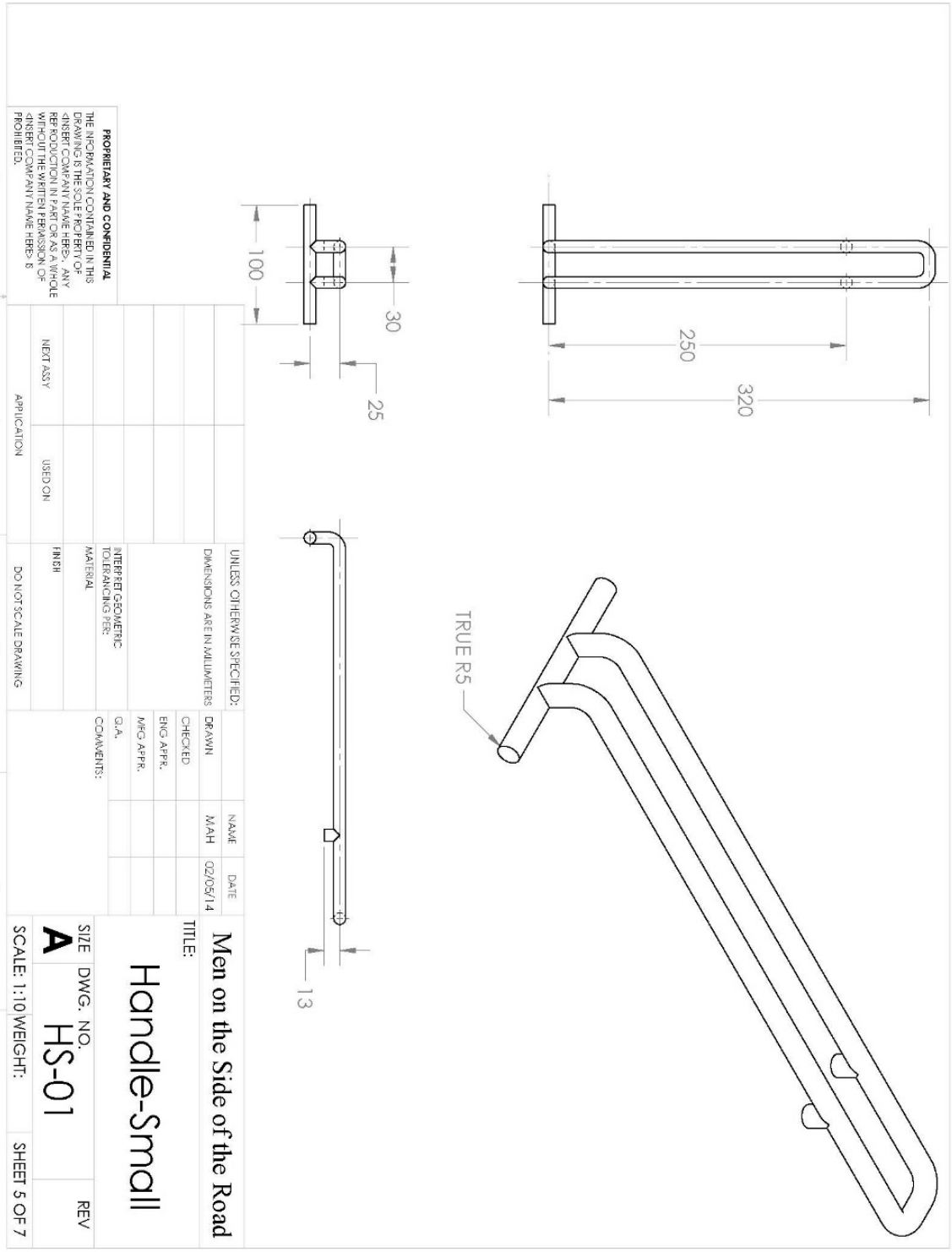


Figure 82: New design of small handle

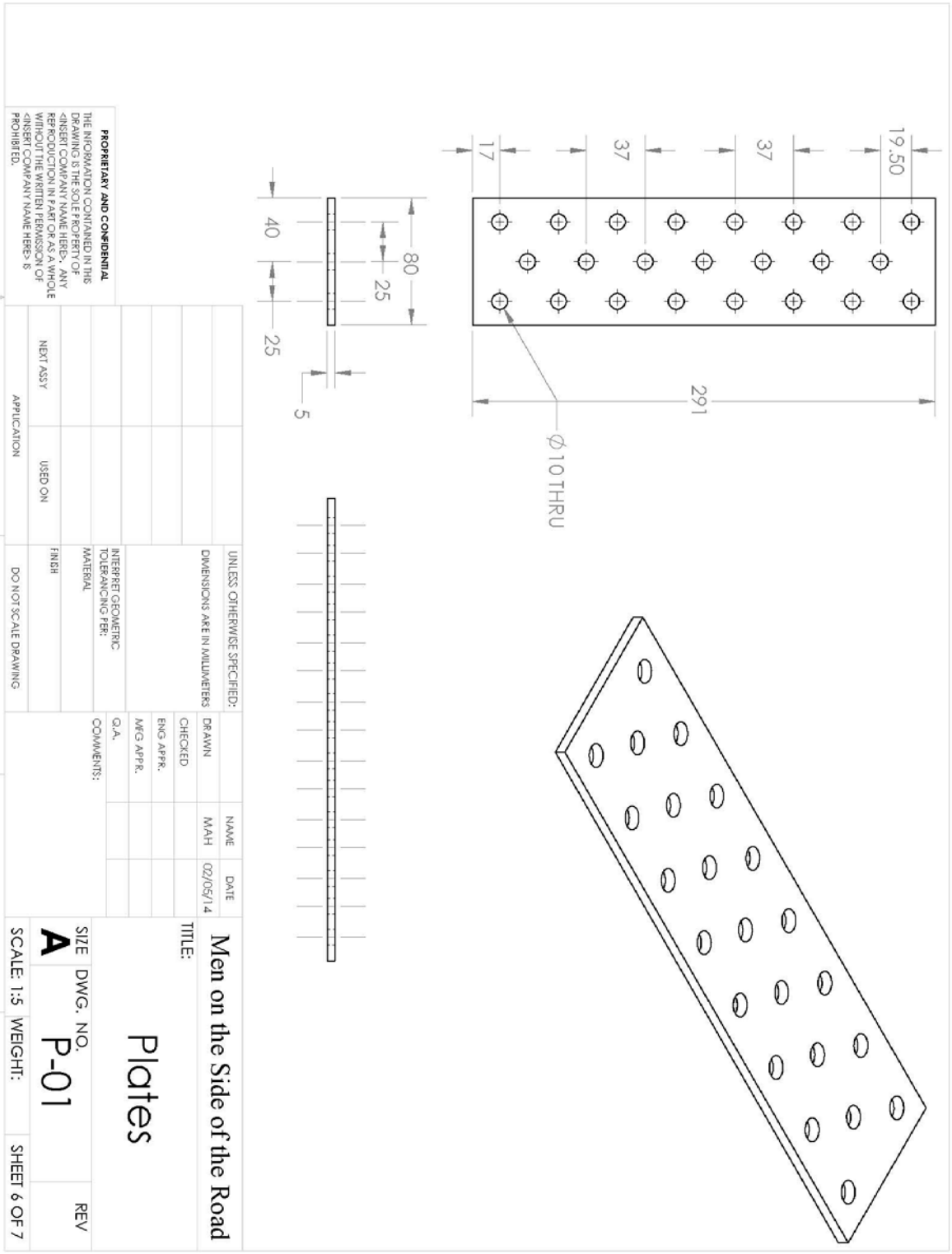


Figure 83: New design of top and bottom plate

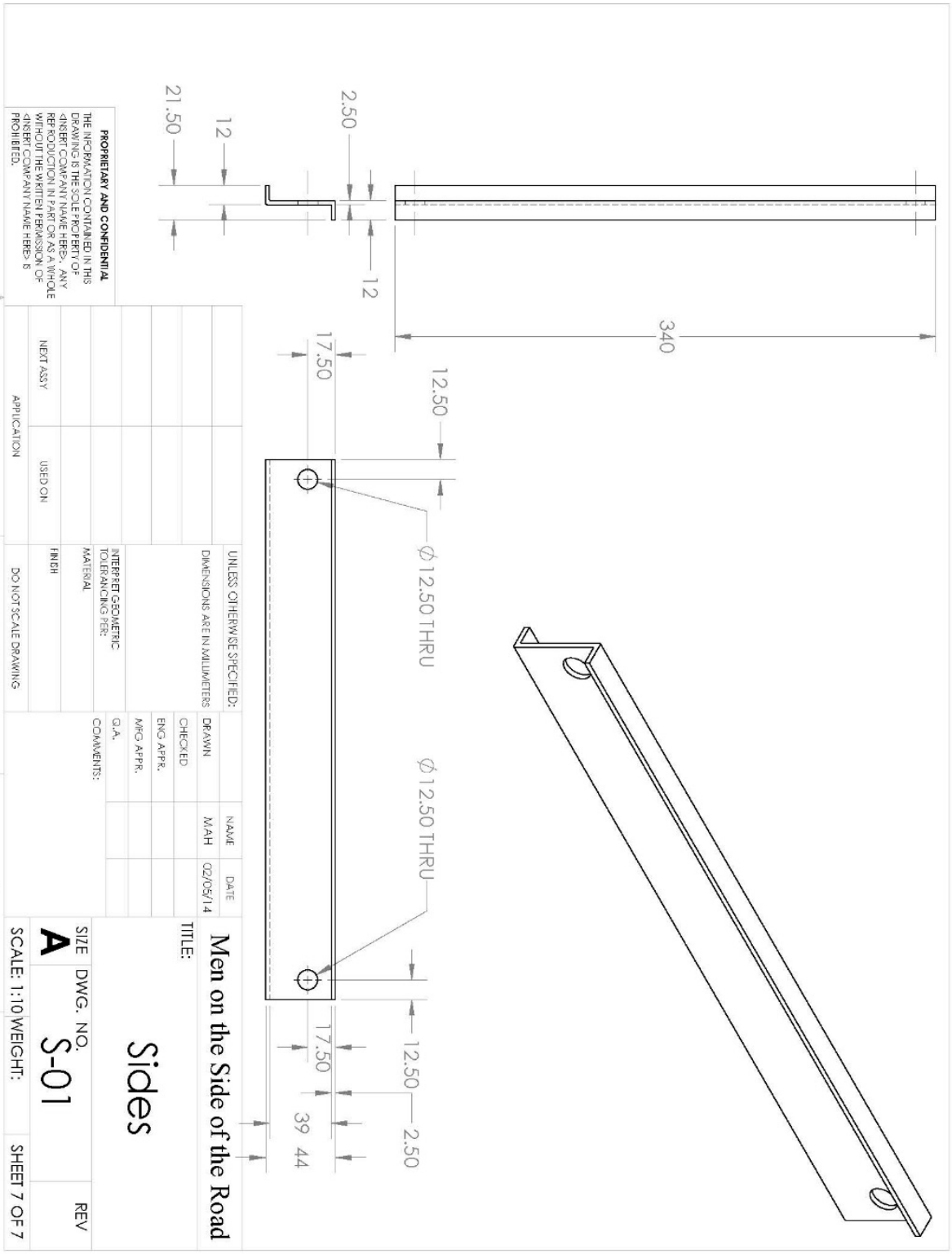


Figure 84: New design of side plates