Design with Social Impact for Rural Communities in Africa
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ABSTRACT
Using four case studies from rural Africa, this paper examines the significance of design in solving social problems. The first three cases are of solar energy innovations in rural communities in Kenya and Uganda. The innovations in these cases demonstrate how design can be used to meet pressing needs and improve the social welfare of low-income rural communities. In the fourth case study a multidisciplinary team of designers and health workers co-developed a health training manual. This case demonstrates a multidisciplinary methodology for social design. In the analysis, the first three cases provide a contextual approach, while the fourth case provides a methodological framework for engaging in social design. The case analyses are then used to propose a Distributed renewable energy (DRE) system that can be expanded to meet other social needs of rural communities in Africa.

(Key words: Africa; Rural communities; Social design; Social impact)
1. INTRODUCTION

The social agenda of design has widened beyond product design and styling. Designers are now giving greater attention to the philosophical underpinnings of design as a process and practice (Manzini 2014; Papanek & Fuller 1972). For instance, designers are getting more involved in trans-disciplinary research contexts that aim to implement processes of societal change, as opposed to simply offering technological product solutions (Ambole 2016). To do this, designers employ ethnographic approaches in efforts to achieve greater social impact through traditional and new design processes (Gunn et al. 2013). To demonstrate the significance of a widening social agenda of design, the four case studies of this paper are used to provide the contextual and methodological approaches for conceptualising a DRE system for rural communities in Africa.

The focus on rural communities is necessitated by the fact that African populations are still largely rural (at 60%) and also sparsely distributed (Un-Habitat 2014). The sparse distribution means that supply of infrastructure and services is expensive compared to the supply in densely populated urban areas. Distributed systems are therefore an attractive alternative for such rural communities.

1.1. Case study 1: A solar Milk Cooling System in Eldoret, Kenya

A recent media programme in Kenya highlighted the plight of small scale dairy farmers who lose millions of litres of milk every year due to unreliable electricity supply. The farmers who suffer the most from this loss are small scale farmers who make up 60% of the milk producers in Kenya. Typically, they are rural based, most of them are not connected to the main electricity grid and therefore have no refrigeration facilities. The farmers milk their cows which are on average 5 manually, and use metal or plastic containers to transport the milk to the collection point, which in many instances is by the roadside. Farmers milk their cows twice daily and they make two trips to the collection point that could be 3 or more kilometres away. Milk has to be cooled to four degrees Celsius, within four hours of milking, when the milk does not reach the collection point in time it is rejected as it will contaminate the rest (KTN News Kenya 2016; Kibui 2016).

One farmer, Willy Kirwa of Willens Dairy Farm, took it upon himself to do something to ease the burden for his family and the community. After extensive research he came up with the solar milk cooling unit. The solar energy powered unit was the solution that he identified to ensure reliable energy that could reduce his loss. The solar milk cooler has a capacity of 600 litres that was way beyond his production capacity. As a result, he mobilized the farmers around him to optimize the use of the cooler. The original investment of 5 million Kenya shillings (US$ 50,000) was provided by Kirwa himself. Through extended services to other farmers, Kirwa is able to get some of his investment back. He is encouraging other farmer’s groups to mobilize resources and set up solar cooling systems. Kirwa fits the description of a lead user as described by Von Hippel (1985) being that he felt a discomfort in his situation and proceeded to do something about it.

![Figure 1] Willy Kirwa with his solar milk cooling system (Source: www.nation.co.ke; 2016)

The solar milk cooling system was developed by a team of engineers from the United States of America identified by Kirwa. Kirwa is very happy with the system and he is looking forward to increasing its capacity. Presently the tank
capacity is 600 litres and it can keep milk for three days. He is also suggesting that farmers get into groups and purchase the systems because he has experienced the benefits.

1.2. Case study 2: CoolSystem in Uganda

There are other examples from Africa such as the rural Uganda situation. Kisaalita, an engineer in Uganda, saw that farmers were losing money in the milk production chain and he sought a solution to what he saw as a need to, "Find a way for the milk to be cooled so that it can either enter the formal or the informal market, where it can fetch a good value for the farmers." He saw that the farmers were losing up to half of their milk output. He started searching for a solution in order to boost farmers’ profits and by extension increase food production in Uganda (Taylor, 2009).

The CoolSystem is intended for use in remote areas without electricity and its use can be expanded to include preservation of other products that require very low temperature such as fruit juices and to keep medicine and vaccines. As a back-up system to areas with unreliable electricity, the system can provide lifesaving support. While the CoolSystem tank has immense benefits for rural households it may be investigated further for Sustainable Product Service System (S.PSS) (Vezzoli et al. n.d); in which case the designers would be examining the materials used in production, the production systems and the after-life. SPSS may require that the manufacture consider a pay per service system or a milk pooling system.

Kisaalita, reengineered the CoolSystem beer cooler, which was originally manufactured to meet the needs of affluent beer drinkers in Europe and Asia, and adapted it to the needs of smallholder dairy farmers in his home country (Taylor, 2009). Working with farmers on the ground, Kisaalita (2009) has mobilized 50 farmers to benefit from the CoolSystem units. These are small holder farmers because they are the ones who suffer the most due to lack of electricity. The farmers will pay back the cost of the units (estimated at between US$ 600-US$ 800) and after about nine months own the units. Unlike the Solar Milk Cooling Unit in Kenya that serves a local community, the CoolSystem is a single unit and although it reduces poverty and is sustainable to the extent that it is made from recycled beer barrels, has less advantages.

1.3. Case study 3: Kitonyoni Solar Mini-Grid Project in Makueni, Kenya

In a village in Kenya, Kitonyoni, a more scaled up solar system provides reliable electricity to more than 50 business, more than 500 homes and many community services such as school and health clinics. Kitonyoni is a community cooperative initiative that has seen the installation of a solar power station that provides the village with reliable electricity. A direct result is that the businesses can operate longer hours, there is increased security and they can use electricity driven equipment and machinery. The villagers enjoy electricity in their homes and can charge their mobile phones and lanterns conveniently. The model as promising includes a canopy to harvest rain water, energy supply that combines electricity for normal use as well as pumping water to the homes, additional revenue for the cooperative and scaling of approach. the Kitonyoni solar system fits into a Distributed Renewable Energy system and the benefits are more than any of the other two cases discussed earlier. Figure 2 shows a solar energy plant in Kitonyoni, Makueni County, Kenya (Energy for Development, 2015).

[Figure 2] Kitonyoni village solar plant (Source: energy for Development, 2015)

Health workers especially in the rural areas are often faced with challenging situations that require quick research or information. They often do not have sufficient time to look for information in some of the available books and manuals. Their major obstacle was that the information they needed often, was scattered in several books, making it difficult to identify and access the information. Many of the rural health workers work away from their offices or clinics and therefore they could not carry around all the reference material that they need for field work. Field workers also felt that the information contained in the reference books were inadequate for their everyday needs.

Arising from this, a collaborative team of clinicians and communication designers embarked on the development of a training and reference manual that contained the information that many health workers need while in the field. The aim of the manual was to provide timely information to health workers for prevention, treatment and management of disabilities. To this end it aims to prevent, reduce and manage disabilities.

The health workers working with the general public were experiencing challenges many of which were interrelated. The identification of the core team was informed by two interrelated ministries that housed health workers. The Ministry of Public Health had a mandate to enhance public health which in turn would reduce disease and thus develop a healthy public. It was argued that many man hours are lost due to preventable diseases. A case in point was the ‘hand washing campaign’ in which school children and the general public were informed of the importance of hand washing after toilet visit. This type of preventive campaign was part of the public health driven campaign.

There are several other campaigns such as Tuberculosis (TB), HIV/AIDS and malaria. Ministry of Medical Services that is concerned with treatment and management expressed concern on for example, unsafe home deliveries, untimely or lack of vaccinations and preventable illnesses. Between the two ministries, the health workers identified preventable risks to unborn, birth, children, adult and aged populations.

Their concerns were

i. The reference information that they need when they are in the field are docile in many health booklets that they rarely able to carry on them.

ii. Some of the information is not domesticated to their needs in terms of for example, available dietary interventions for children. Some geographical regions do not have recommended foods for infants or mothers and no alternatives are suggested.

iii. Reference booklets are not comprehensive so that for example, a booklet will deal with delivery, but not the pre-natal care or post-natal care.

iv. The vulnerable groups especially those with disabilities such as hearing, visual and physical, are not considered in the development of the available booklets. For example, the health workers were concerned that hearing or visual impairment especially in children could be prevented, managed or even treated through early and timely intervention. Several exercises were identified for intervention in children to prevent rickets.

v. The health workers were concerned that negative cultural practices some of which were never talked about were an impediment to healthy development of the public. For example, diet, where children and mothers were prevented from consuming appropriate foods due to culture.

vi. Lack of skills in illustration, layout and understanding/representation of colour meant that some of the available booklets misrepresented information while others were poorly designed. As a result, the health workers could not use the booklets effectively especially during emergency.

The design challenge: With the identified communication challenges, the final manual had to be multi-sectoral, easy to reference and appropriate in size and content, and developed with the available resources.

The Multidisciplinary team: The team had 27 members who included designers, administrators and technical experts. The technical experts were drawn mainly from health workers and clinicians who represented field health workers. They were drawn from two government ministries namely Public Health and Medical Services. They were: physiologists, nutritionists and dieticians, sign interpreters, nurses and clinicians. The designers were graphic designers, photographers and illustrators. The two groups were joined by the sponsors of the manual who facilitated the team and provided administrative and logistical support.
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<th>Institution</th>
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<td>University of Nairobi</td>
<td>School of the Arts and Design. Layout artists, illustrators, Graphic designers, photographers.</td>
<td>5</td>
<td>Designers</td>
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<tr>
<td>Association of The Physically Handicapped of Kenya (APDK)</td>
<td>Facilitating agency/Logistics</td>
<td>3</td>
<td>Administration and logistics</td>
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<td>Ministry of Public Health</td>
<td>Nutrition, Vaccination, Sign Language expert, Child, Adult, Aged.</td>
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<td>Technical experts</td>
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<tr>
<td>Ministry of Health</td>
<td>Physiotherapists, Midwives,</td>
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Co-creation: Typically, the design process takes place in a design studio and involves designers developing a new product following a five or six phase process. The design process was considered a creative activity that could not be discerned by "non-creatives." This has changed dramatically over the last few years and today, new products are a result of collaborative design teams that includes users of the products. The manual development was one such case in which the team engages in an intensive two-week exercise to develop an effective acceptable training manual.

The health workers were experts of their experiences in the field. They provided the technical content, the roles of the designers, health workers and facilitators keep changing and often mixed up. In co-design, "the person who will eventually be served through the design process is given the position of "expert", and plays a large role in knowledge development, idea generation and concept development (Sanders & Stappers, 2008).

In conceptualization, the designers were providing a supportive role by visualizing and providing alternatives from listening to the health workers. The designers were giving form to the abstract ideas, and providing expert advice on methods of visualization and presentation. The designer was alternating between leading, guiding, directing and mediator between the creative team (illustrators and graphics’) and the technical team (health workers) while maintaining an understanding of the sponsors (who had a budget ceiling on the project).

The design process started with identification and review of documents. These were documents that included those that are in use, some documents from other parts of the world that were found relevant for various reasons. The literature review was undertaken according to specific themes. The main activity was an intensive two week brainstorming session in which the designers translated the ideas and information into a manual.

Layout: One of the first issues in the initial stages involved determining the layout of the text and manual size. The health workers were shown three prototypes and asked to establish which particular one served them best. Of the A4, B4 and C5 size options, they opted for a C5 size. Most of the field workers are ladies and they felt that the size fitted best into their handbags or carry-ons. It was also established that the manual would be limited to a certain number of pages so that it is not too bulky and difficult to use. With the page limit established, it had an impact on the font size and illustration sizes.

The page was divided by grid system and clustered using colour coding. The colours were toned down for ease in photocopying where necessary. They were also used to ease identification of information. The considerations for the cover page was the focus on the family unity with the mother, father and children. It was important that they look representative of the target persons or most of the population of Kenya.

Illustrations: Illustrations was one of factors that concerned the health workers most. The preference was line drawings filled with flat colour. This is because the line drawings were most effective and direct in communication according to the health workers. Drawing inspiration from the Kenyan environment and keeping in mind that the manual would be used in the rural areas.

The reference manual is a one-stop reference point for a wide range of health information. Furthermore, it looked at the local Kenyan environment and sought to draw relatable imagery from it, for example: local fruits, vegetables and meats. In cases where the fruits vary from one region to another, care was made to acknowledge the difference and
2. DISTRIBUTED RENEWABLE ENERGY (DRE) SYSTEMS

Renewed and aggressive focus on sustainability is based on the global trends that show that continued harvesting of the worlds non-renewable resources will be disastrous for the world. Effects of global warming (el nino and lanina) and depleting forest cover and reduced food production are some of the things we can relate with directly. The Sustainable Development Goals (SDGs-2014) that have taken over from the Millenium Development Goals (MDGs) have outlined wide reaching initiatives that can mitigate global destruction. the initiatives are clustered around seventeen principles including poverty reduction, education, food security and increased use of renewable energy. Renewable energy for single units is a good starting point, however, a distributed renewable system ensures a more reliable source of energy (Vezzoli et al. 2015).

In a village like that of Kirwa, and others like it, solar power will not only provide them with a source of livelihood, but can be expanded to meet their everyday need for energy. In Iksaya village, Kenya, the village solar energy centre that generates 2.16 KW, provides affordable and accessible basic lighting and electricity services. This energy is sufficient for lantern charging and renting, battery charging, phone charging and IT services among others.

DRE provide opportunity for providing reliable sustainable electricity especially in Kenya that has reliable sunshine most of the year. DRE works very well where there is a cohesive community and therefore Kirwa's farmers make a good group. Apart from the solar power, the farmers can explore biogas since they own cows that are semi confined which makes biogas harvesting relatively easy. The solar system installed by Kirwa is reliable and although the area is connected to the main grid, they should make the solar system the main source and use the main grid supply as a back-up in case the solar does not function properly or is undergoing routine maintenance.
2.1. Lead-user Innovations

Kirwa as stated earlier fits the description of a lead user. The Lead user concept is typically associated with market research especially in highly competitive markets. However, von Hippel (1982) states that the concept can be applied to broader situations that require innovative solutions. The significance of Lead users to new products and systems is two-fold, namely, that the lead users present discomfort will become generally felt by the rest of the users in the future. For this reason, if carefully observed lead users will provide the much needed future projections on product or service innovation. This is important for the manufacturers and producers. Lead users are proactive so in many instances they will make attempts to find solutions to the problems they have. So, a lead user such as Mr Brinks (CPUT, 2015) develops products that work for them.

In South Africa, Brinks having been born with a disability has designed many products for persons like him. To be able to commercialize his products, he has collaborated with Cape Peninsula University of Technology (CPUT). The success of Cookable™ which is one of his products, can be attributed to the fact that it was conceived by himself as the person who was experiencing the discomfort in the kitchen. It can slice bread, open cans, grate and peel among other functions. This product is one of several that have been developed by Brinks, and they are all borne out of necessity, as he attempts to perform everyday functions to the best of his ability. Brinks, fits the description of a lead user as defined by Eric von Hippel.

For manufacturers and producers, a close relationship with the lead user will save on resources required to undertake elaborate market research. The Lead user, has product solutions that have not been commercialized, because often, they are developed for their own use. Mr Brinks developed the Cookable™ because of his disability that limited his ability to undertake certain functions in the kitchen. the Cookable™, later attracted research and development teams including the Cape Peninsula University of Technology, that proceeded to make it into a viable product for commercial production. (CPUT Innovation: Cookable™, 2015).

Apart from lead users, sustainable products can be initiated by local communities, governments and other interest groups. However, in all these situations, Okure, an engineer from Makerere University (Okure 2014) states that consultation is crucial. Individual and public meetings to explain roles and impacts (both positive and negative) of the project ought to be conducted as early as possible to assure success and mitigate hurdles such as access, permits, sales, connections. The above statements serve to contextualize Kirwa, the farmer who invested his savings in research and development of the solar milk cooling system as a lead user. The milk cooler serves his personal needs of preserving his milk and thereafter, surplus capacity is provided to his community.

In the absence of evident lead users, the designers are required to have skills to be able to empathise with the users and do something about their situation. In most cases the designer is able to do that but it could be an engineer like Kisalita of CoolSystem, a behavioural scientist, government or community leader like in the case of Kitonyoni. The important thing to note is that products developed without the user’s indulgence have less success in the market.

2.2 Social Design Process

The case studies of this paper, demonstrate the importance of design in the social processes: The milk cooler by Kirwa was lead-user driven and the design and engineering team worked with the individual in product design. In the CoolSystem, the motivation for the design is informed by careful observation of the rural people in Uganda. Without a prior commitment to the problem or solution, students from Makerere university and University of Georgia (United States of America) spend eight weeks on the ground, researching and understanding the livelihood of the people. In Kitonyoni, the design process was also human centred, a solution to socio-economic problems of the community. Poverty reduction was a key consideration and with it was health, education, household incomes, clean water and security. A lot of effort was put into community mobilization and project ownership. The Cookable™ is an example of applied principles of Universal design (M’Ritha, 2015). Products developed using UD principles serve the disabled persons, but are even more widely acceptable to the majority of people (Osanjo, 2015).
co-process involves designers and people not trained in design working together in the design development process (Sanders & Stappers, 2008).

Human Centered Design (HCD) has twelve thematic areas that includes Design for communication, Design for Specific Culture, Design for Energy and Design for Health (Paulson, 2014). HCD is driven by the needs, desires and context of the people for whom we (designers) design. In the exercises that were undertaken in the LeNSES project, users were defined through persona profiling (Vezzoli et al. 2016). The question that the profiling answered was, "Who is the intended focal person within the system?" Sometimes it was schoolchildren (like in Botswana) who needed quality and reliable lighting to do their homework. Or it was the entrepreneur from who other community members would tap the energy like in the Kenya situation. In all the cases, a clear identification and understanding of the user informed the design process.

![Human Centred Design](image)

**Figure 3** Human Centred Design approach for DRE (Source: Paulson 2014)

### 3. A DRE FRAMEWORK FOR RURAL COMMUNITIES IN AFRICA

In synthesis, the contextual and methodological concepts that have emerged from the cases of this paper are now used to propose a DRE framework for rural communities in Africa.

- **LEARN**: multidisciplinary teams can be set up by institutions or initiated by lead-users in the community. Such teams need to learn from each other and form a shared understanding of the problem
- **EMPATHISE**: after forming a shared understanding, the team needs to immerse itself into the social and cultural context of the problem. In the case of rural communities, cultural sensitivity in the team is of prime importance
- **IMPLEMENT**: the team should then proceed and implement their co-created solutions in collaboration with the communities they seek to help. In the implementation, the team can make use of HCD approaches that facilitate the social design process

In conclusion, emphasis is laid on the need for expanding the social agenda of design to meet the needs of rural communities in Africa, that still make up over 60% of the population. This will require a paradigm shift in design practice and training so that designers are equipped with the skills to lead and participate in multidisciplinary design teams, made up of experts and facilitators and community members. Such teams are best placed to co-learn, empathise and co-implement DRE systems that meet pressing energy needs, while also enhancing other social benefits for rural communities.
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