

# SHIFTING THE SYSTEM

## HARNESSING THE POWER OF ENGINEERING TO ADDRESS POVERTY

*By Allison Langille*

Earlier this year, PEO began a working relationship with Engineers Without Borders (EWB), a development organization that utilizes engineering skills to find practical solutions to one of the world's most urgent issues: extreme poverty. The PEO-EWB arrangement involves sharing resources, promoting the work of EWB among Ontario's nearly 80,000 licence holders and engineering interns, and providing opportunities for P.Engs to become EWB members and to work on projects in Africa, where EWB is working on improving reliable access to clean water and critical infrastructure. PEO President Diane Freeman, P.Eng., FEC, has referred to the PEO-EWB relationship as an example of "designing for the people who need us," and says that such a community-minded approach to engineering highlights the important and relevant role of licensed professional engineers in the areas of technical design and social policy.

In pictures, Malawi is lush with greens and blues and, at times, closely resembles a kind of paradise. Nestled on the coast of South Africa, the country is home to over 13 million people. Yet, what you can't often see in the vibrant pictures of clear lakes and rich forests is the persistent failure of clean water sources.

Across Malawi, there are about 40,000 clean water points, such as wells and boreholes that, in theory, serve around 10.4 million Malawians. Yet, after five years working in Malawi's water sector, EWB knows the reality of this is quite different. The problem: 25 per cent of Malawi's water points are broken and 15 per cent are clustered together, leading to inequitable distribution. As a result, only half of Malawi's population has access to a functioning source of clean water.

The impact of this reality is that thousands of Malawians perish each year from preventable water-borne diseases. The failure lies not in a lack of interest, funding or even the technology itself—rather, it's a persistent and complex systemic breakdown.

"Solutions are rarely only technical, and in today's world it is the organizational systems and the humans within them that make things run," says Luisa Celis, P.Eng., who works with EWB's governance and rural infrastructure team in Ghana. "This means that long-term sustainability takes more than a one-off project, and rather long-term systemic change; this requires patience and persistence."

### **AN UNNECESSARY COST**

Dan Beck, a software engineering graduate from the University of Victoria, has been working in the Mponela district of Malawi for the last six months to address the non-functionality of water sources in remote communities. A few months into his time in Mponela, Beck was travelling by bicycle with a mechanic named Devson to assess the func-



Functioning borehole: Looking at water point functionality as a system, instead of drilling more wells, can mean continued access to clean flowing water for Malawians.

tionality of the hand pumps needed to access the water from the boreholes in several villages.

Chauwa was one such village, and when Beck opened the lid on the community's broken hand pump, he was frustrated by what he saw.

The fulcrum pin—which would normally last more than 10 years when maintained properly—was sheared off from strain. The pump head was nearly cut through from rubbing and the holes meant to hold the fulcrum pin in place had gotten so large from wear that, unless the community purchased some large washers, the pins would break in the next four to six months and render the pump useless. The bolts holding the pump together had worn down and were impossible to remove.

Beck saw that the pump's bush bearings were completely broken. Given their purpose is to ensure that as water pumps out, the lever stays firmly in place, it was no surprise that the other components of the pump were badly worn and broken.

According to Beck, "It looked like the bush bearings hadn't been replaced in about four or five years."

Drilling the well and constructing a hand pump is only half the job. When there is no consideration for establishing ongoing maintenance services and access to the parts with a known lifespan, like bush bearings, wells in rural villages are destined to a future of non-functionality.

"Seeing this situation is incredibly frustrating. New bush bearings cost about \$1 each—and they

only need to be replaced about once every two years or so,” notes Beck.

If properly maintained, the four bush bearings in Chauwa’s hand pump could be fixed for a total of \$4; however, the issues caused by continued use with broken bearings now required about \$30 in spare parts to fix. Even if the village could afford the repairs, which villages like Chauwa generally cannot, the parts are often not accessible to remote communities.

### INCORPORATING MAINTENANCE

During his time in Mponela, Beck worked in partnership with InterAide, a large French develop-

ensuring the functionality of their water source by paying a fee for the mechanics’ services.

But even this innovative solution has proven difficult. The precedent has been set in Malawi that a donor agency will eventually drill a new well or repair water points for free, and for a while the community will have clean water again. When that well inevitably breaks down, a community will simply have to wait until the next donor comes along. There is no lack of donor dollars dedicated to drilling new wells, which perpetuates this inefficient cycle.

“Until the systemic issues are addressed when implementing infrastructure, projects will continue

to fail the most vulnerable communities who need services—like quality education and clean water—the most,” says EWB team leader Daniel Olsen, P.Eng.

After several years working to hypothesize where the root cause of Malawi’s clean water woes stems from, EWB members like Beck, Olsen and Celis are working to build innovative solutions to systemic failure. Through partnerships with organizations like InterAide, they are building the capacity of local leaders, creating a system that will increase a community’s willingness to pay for a clean water source, and implementing networks to deliver ongoing maintenance and spare parts.

Beck is hoping to implement one such solution. As a result

of his experience with InterAide, and with expertise gathered by other EWB volunteers, Beck has helped design a plan to scale up the area’s mechanic approach. The plan consists of identifying, training and supporting 100 local mechanics—responsible for an impressive 6000 water points—to ensure a growing number of Malawians can access the repair services needed to keep clean water flowing.

What Beck has realized from visiting village after village in Malawi is that the challenge of broken clean water sources is rooted much deeper than ineffective technology. With this in mind, pilot approaches, like those developed by InterAide and now Beck’s work, are proving that systemic issues—like limited access to spare parts or maintenance expertise—cause a



Broken hand pump: Something as simple as a broken bearing can eliminate water for thousands in rural Malawi.

ment organization, to break the cycle of suffering associated with limited access to clean water. Recognizing that one of the root causes of long-term failure in access to clean water in Malawi is lack of maintenance for technologies such as hand pumps, InterAide was testing a new approach to building the capacity of local area mechanics to repair and monitor clean water points.

InterAide’s solution proposes a network of mechanics responsible for maintaining water points across a series of rural communities, and the necessary supply chains for spare parts. The approach is uniquely tailored to the systemic breakdown: it makes maintenance expertise and spare parts available and encourages the community to take ownership of

breakdown in access to clean water for thousands of rural Malawians.

However, this problem is not isolated to Malawi or to the provision of clean water.

### **BROKEN EDUCATION INFRASTRUCTURE**

When volunteer Shamir Tanna arrived in the rural district of Saboba, Ghana, from his hometown of Mississauga, Ontario, in 2008, he was struck by the sheer number of newly constructed buildings—and the fact that most sat

empty. Although he was a newcomer, Tanna could already see that Saboba was a bustling and vibrant district, so he could not imagine why so many new buildings would sit idly by. Never one to be shy, Tanna asked a passerby why this was the case.

“These buildings—all schools and clinics that we greatly need—remain empty because there are no teachers, no supplies,” said the local. “The only thing that has changed in Saboba in 15 years is that there are more buildings. We still do not have access to the things that we need.”

A few days later, with this experience fresh in his mind, Tanna began his work at Saboba’s small government infrastructure planning office. While he was sifting through government documents in the office to identify the basis on which Saboba plans its infrastructure, Shamir met Tindam Douglas.

“Your search is going to be difficult,” said Douglas. “We have never collected or analyzed data to determine the location of a school or a clinic. Anyway, I am not sure we could, because donor funding usually determines where we can place the new buildings.”

It was then that Tanna began to see why he was met with a host of empty buildings upon his arrival to Saboba. “Building a school is the easy part and often the result we see,” he says. “But the fact is that Ghana’s planners need to have and analyze a lot of information about the services, the available resources, and the community to ensure that a school will actually function and improve the lives of those around it.”



A health clinic constructed in 2007 in the town of Lunto in Kpandai District Assembly has never been used due to a bat infestation. It is just one example of poorly delivered infrastructure in Africa.

### **INFRASTRUCTURE PLANNING**

In Ghana, public service planning and delivery is infrequently based on evidence and analysis and, like Malawi’s water sector, is heavily driven by donor priorities. What Tanna saw first-hand was the result of this broken process—understaffed clinics, empty schools, unequal distribution of water wells among the population and sometimes roads that have been poorly (if at all) planned, implemented and maintained.

Effectively planning infrastructure in Ghana is incredibly challenging. There are few widespread mechanisms by which district planners capture data to identify where public services are most needed. The result is individual government ministries and development organizations taking their best guess at what services rural Ghanaian communities need to improve their lives.

Even if the raw data was widely available, Ghana’s district planners have infrequently been required to make evidence-based infrastructure planning decisions. Both the incentives and the required skills are missing and, as a result, data would sit unused. Districts like Saboba are just the beginning, because both at the regional and national levels there are no effective mechanisms to vet and implement infrastructure plans, as well as monitor them over the long term.

“Before arriving in Ghana, I worked for three years as a project manager at a large multi-national engineering consulting firm in Toronto,” explains engineer Olsen, who leads EWB’s governance and rural infrastructure team in Ghana. “I took for granted that both our company and our clients at municipalities had the necessary data management systems and expertise in place. If these underlying systems were not functioning, projects would be destined for failure.”

With this in mind, EWB has spent the last four years building relationships in all aspects of this complex system, taking action, and seeing results.

### TRAINING PLANNERS

After arriving in Saboba, Tanna began working closely with the various government departments in water (where Douglas works), health, education and sanitation to improve their data gathering and organization skills. This meant inputting and manipulating data that government leaders were collecting, and also analyzing results from a survey that had been completed in Saboba in 2008 and from the National Population Census in 2010.

To make the results more tangible, an EWB member in Canada developed a script to pull maps and pivot tables from raw data, a tool that was later used to better map water points in Malawi. Using Microsoft Excel, a program that was readily available on most computers in Ghana, Tanna was improving the sustainability of the training he provided.

Tanna worked with government leaders in Saboba like Douglas, over several months, building their capability to draw planning conclusions based on data analysis. Because of Tanna’s support, Saboba recently completed an important four-year infrastructure planning process. For the first time, the district prioritized service delivery by explicitly using data from Saboba’s communities.

Although this progress is currently focused in districts like Saboba, EWB is working with leaders

at the regional and national levels to institutionalize the training approach. This is taking time, as trust, credibility and expertise are being built each day within an ever-changing system ripe with a long history of ineffectiveness.

“In the areas we work, leading politicians and donors are beginning to change the programs and projects they administer to fit the data and plans from informed and specialized government officials—like Tindam,” says Tanna.

### SUPPORTING SYSTEMIC CHANGE

For EWB, the challenge is not about drilling a new well or erecting a new school. It is in the failure of many of these interventions that EWB members like Beck, Tanna, Olsen and Celis are taking a critical approach to identifying reasons for systemic breakdown. They do so using the analytical and problem-solving mindset they have been taught through their engineering training. Because of this, they are able to foster pragmatic and innovative solutions to the core reasons why poverty exists in countries like Malawi and Ghana.

Taking a long-term and systemic approach is not always easy. But we know that this is how engineers are helping thousands of rural Africans change their lives.

“Whether it’s keeping clean water flowing in Malawi by improving water pump maintenance and repair systems, or helping Ghana’s district planners improve their data-gathering and analysis skills to better deliver public infrastructure and ensure quality education services for rural families, we know engineers are equipped with the necessary problem-solving and management skills to address urgent global challenges,” says George Roter, co-CEO and co-founder of EWB. “Our new agreement with PEO strengthens this by connecting members to volunteer opportunities, and providing an easy way to financially support EWB as the charity of choice for Canadian engineers.” Σ