



# 2022 IMPACT PROJECTS REPORT



By Engineers, For Everyone.

engineering **FOR**  
**CHANGE**  
By ASME

A year's overview

# IMPACT PROJECTS



Engineering for Change (E4C) is a non-profit organization dedicated to preparing, educating, and activating the international technical workforce to improve the quality of life of people and the planet. We cultivate change agents by providing resources, platforms, and access to expertise to accelerate the development of solutions and infuse engineering into sustainable development.

E4C was founded jointly by the American Society of Mechanical Engineers (ASME) and other leading engineering societies.

E4C Impact Projects advance the sustainability objectives of impact-driven organizations by sourcing exceptional talent through our Fellowship Program to address critical design needs and research questions to advance the UN's Sustainable Development Goals. Impact Projects fall into one of our three key streams: Design for Good, Impact Research, and Advancing Workflows.

E4C 2022 Program Management Team:

**Jonathan Kemp**, Program Specialist

**Erin Peiffer**, Program Coordinator

**Carolina Rojas**, Program Associate

**Anna Libey**, Interim Research Manager

**Sahar Shamsi**, Interim Research Manager

Published February 2023

In 2022, E4C welcomed our largest Fellowship cohort ever: 57 Fellows from all over the globe. This year, the Autodesk Foundation collaborated with E4C to support 25 of these Fellows, matching them with practical design and research projects from the Autodesk Foundation's portfolio of nonprofits and startups. These savvy early-career designers and engineers from all over the world drew on their experience and expertise in Autodesk technology to provide tangible impact for their partner organizations. Projects included development or improvement of products, advancement of workflows in organizational design and Autodesk technology, and targeted research.

In 2023, the Autodesk Foundation and E4C are collaborating again to provide grantee organizations the opportunity to receive targeted technical support while simultaneously growing the human infrastructure and local capacity of the next generations of technical professionals.

**Read full reports at:**

<https://www.engineeringforchange.org/research/>

**Read more about our Fellowship and Fellows:**

<https://www.engineeringforchange.org/e4c-fellowship/>

**To become a research partner, email:**

[partners@engineeringforchange.org](mailto:partners@engineeringforchange.org)

# 2022 E4C FELLOWS

## SOUTH AMERICAN FELLOWS



**Ana Milena Trujillo Castro**  
Colombia, Fellow

**Christ Ruiz Ortiz**  
Perú, Fellow

**Damiana Pacheco - Aviles**  
Ecuador, Fellow

**Elena Vazquez Peña**  
Paraguay, Fellow

**Francisco X. Plaza**  
Ecuador, Fellow

**Jorge Bravo Villegas**  
Ecuador, Fellow

**Julio Diarte**  
Paraguay, Expert Fellow

**Martin Ignacio Del Pino**  
Argentina, Expert Fellow

**Paulo Vela**  
Peru, Expert Fellow

**Rosakebia Estela  
Mendoza**  
Perú, Fellow

## NORTH AND CENTRAL AMERICAN FELLOWS

**Catherine McManus**  
USA, Fellow

**Charles Newman**  
USA, Senior Technical  
Expert Fellow

**Christopher Mabey**  
USA, Fellow

**Claudia Alemañy - Castilla**  
Cuba, Fellow

**Farid Hazameh**  
Panamá, Fellow

**Gabriel Ayu Prado**  
Panamá, Fellow

**Helen Lindsay**  
USA, Expert Fellow

**Jane Gachucho**  
Canada, Fellow

**Kyla Strickler**  
USA, Expert Fellow

**Lauren Reinersman**  
USA, Fellow

**Sahar Shamsi**  
Canada, Fellow

**Shannon Tin Oi Lee**  
Canada, Fellow



# 2022 E4C FELLOWS

## EUROPE AND NORTH AFRICA FELLOWS



**Katerina Prokopiou**  
Cyprus, Fellow

**Khaoula Trigui**  
Tunisia, Expert Fellow

**Maryam Khaled Ahmed**  
Egypt, Fellow

**Patricia Lamas**  
Spain, Fellow

## WEST AFRICA FELLOWS

**Alex Inoma**  
Nigeria, Fellow

**Deji Adebayo**  
Nigeria, Fellow

**Eleazer Archer**  
Ghana, Fellow

**Ibrahim Walaman-I**  
Ghana, Fellow

**Kingsley Ukoba**  
Nigeria, Fellow

**Nwalo Okechukwu**  
Nigeria, Fellow

**Obiora Odugu**  
Nigeria, Fellow

**Sydney Okoroafor**  
Nigeria, Fellow



# 2022 E4C FELLOWS

## SOUTHERN AND CENTRAL AFRICA FELLOWS



**Eric Bidong**  
D.R.C, Fellow

**Joseph Kurebwa**  
Zimbabwe, Fellow

**Joseph Mdumuka**  
Malawi, Fellow

**Sonna Donko Maël**  
Cameroon, Fellow

**Ben Wokorach**  
Uganda, Fellow

**Brighton Mogoka**  
Kenya, Fellow

**Erion Bwambale**  
Uganda, Fellow

**Frida Korir**  
Kenya, Fellow

**Hamisa Rizgallah**  
Kenya, Fellow

**Isaac Njoroge**  
Kenya, Fellow

**Kithinji Muriungi**  
Kenya, Fellow

**Lorine Ouma**  
Kenya, Fellow

**Nicolas Kalimba Rugamba**  
Rwanda, Expert Fellow

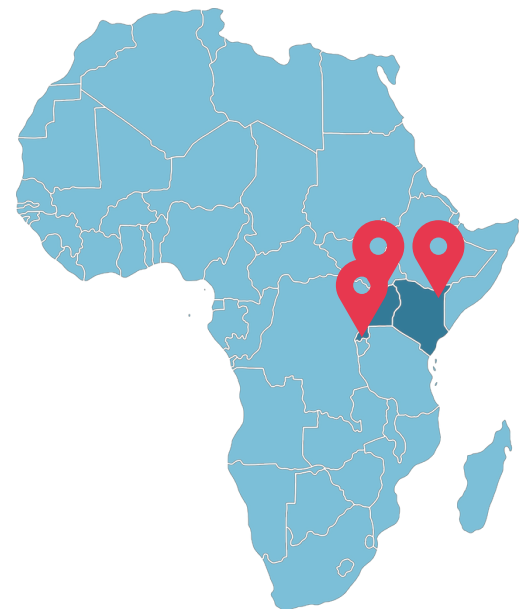
**Racheal Nalwoga**  
Uganda, Fellow

**Sandra Ineza Sinzi**  
Rwanda, Fellow

**Sheila Atieno Ojwang**  
Kenya, Fellow

**Valerie Eve Atieno**  
Kenya, Fellow

## EAST AFRICA FELLOWS



# 2022 E4C FELLOWS

## ASIA AND MIDDLE EAST FELLOWS



**Anish Agarwal**  
India, Fellow

**Arijit Goswami**  
India, Fellow

**Arya Sarkar**  
India, Fellow

**Cheng Heung**  
China, Fellow

**Dean Ashton Plamenco**  
Philippines, Fellow

**Harsh Vyas**  
India, Expert Fellow

**Himanshu Panday**  
India, Fellow and Expert Fellow

**K Shakthi Dhar Reddy**  
India, Fellow

**Mohammed Baaoum**  
Saudi Arabia, Fellow

**Sudhamayee Pochiraju**  
India, Fellow

**Tanvir Khorajiya**  
India, Expert Fellow

# 2022 E4C FELLOWS



19.4%

**NORTH AND  
CENTRAL AMERICA  
FELLOWS**



21%

**EUROPE, MIDDLE  
EAST AND ASIA  
FELLOWS**



16.1%

**SOUTH AMERICA  
FELLOWS**



43.5%

**AFRICA  
FELLOWS**

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# 8 DECENT WORK AND ECONOMIC GROWTH

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## 11 SUSTAINABLE CITIES AND COMMUNITIES

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## 12 RESPONSIBLE CONSUMPTION AND PRODUCTION

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2 ZERO HUNGER



Kheyti

# Structural Design and Optimization for Scaling Steel Modular Greenhouses

Fellow: **Sonna Donko Maël**, Cameroon

Expert Fellow: **Harsh Vyas**, India

Partner collaborators:

**Ashdeep Seth**, Engineering Design Consultant, USA

**Mohit Saxena**, Business Strategy Manager, India

This work was supported by:

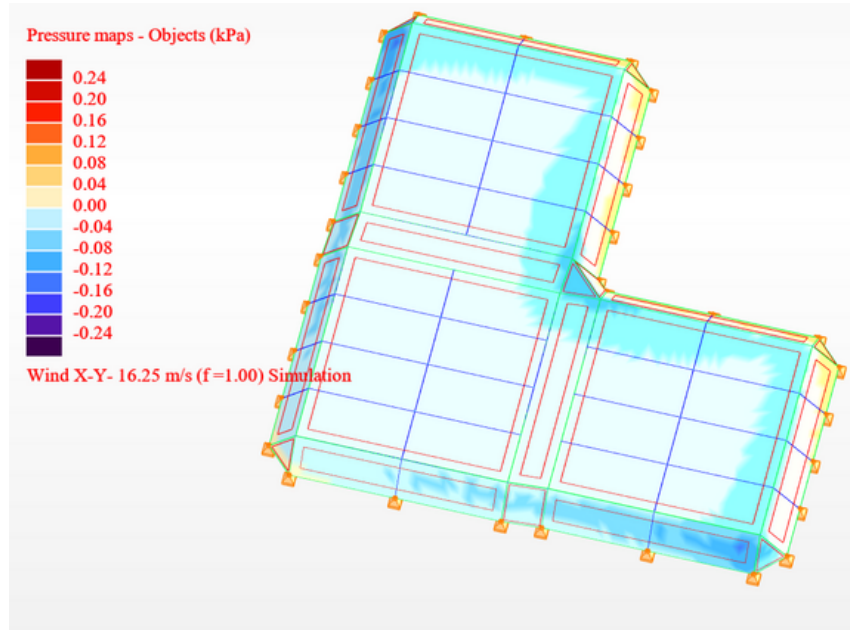
**Autodesk Foundation**

This work is in collaboration with:

**Kheyti**

Autodesk technology used in this project:

**Fusion 360, Revit, and Robot Structural Analysis**



**Diagonal wind pressure distribution on 3 stacked greenhouses (3GH Model)**

The objective of this project was to support Kheyti in performing structural works to provide structurally viable and cost-efficient Greenhouses (GHs) to farmers. This would allow them to provide more modular options (reduced and extended versions) of its current greenhouse-in-a-box, to assure a year-round income for bottom-of-the-pyramid farmers in India.

After noticing how good their activities have been performing, some farmers (both present and future clients) wanted to experiment with larger greenhouses to expand their activities, while others would prefer smaller ones for nursery purposes. As such, it was necessary to verify the safety of the current conventional GH structure, then perform design and optimization works to obtain optimum engineered dimensions and materials for the pipes, wires and foundation of various geometries of the reduced and extended GH structures.

The various parts of the conventional GH were extracted from the existing Fusion 360 CAD files and used in Revit for architectural modeling. Then exported to Robot Structural Analysis where the appropriate loads were applied to perform global analysis, the results were then sent to Fusion 360 for local analysis of the foundations. These structural works helped to assign structurally fit parts to the GHs based on the obtained stresses.

It was found that extending the greenhouses by stacking them together tends to increase the overall safety due to the faces of individual GHs that are being shaded from wind pressures by adjacent GHs. On the other hand, extending by structurally linking the GHs has to be studied case by case but has a tendency to provide safety. The latter option was chosen as it comes with reduced material quantity, thus ensuring cost efficiency. Also, the reduced greenhouses were all safe with the least being the 1/4 GH version. While ensuring safety, cost optimization will be achieved by using lower-strength pipes and/or 5mm balcony cables.

**Outcome:** Design of structurally viable, cost-efficient greenhouses for farmers



2 ZERO HUNGER



# KickStart International Development of a Solar Pump Electronics Design Use Case for Training

Fellow: **Kithinji Muriungi, Kenya**

Expert Fellow: **Kyla Strickler, USA**

Partner collaborators: **Ian Spybey,**  
Director of Product Intelligence &  
Development, Kenya  
**Cynthia Musonye,** Electronics  
Engineer, Kenya

This work was supported by:

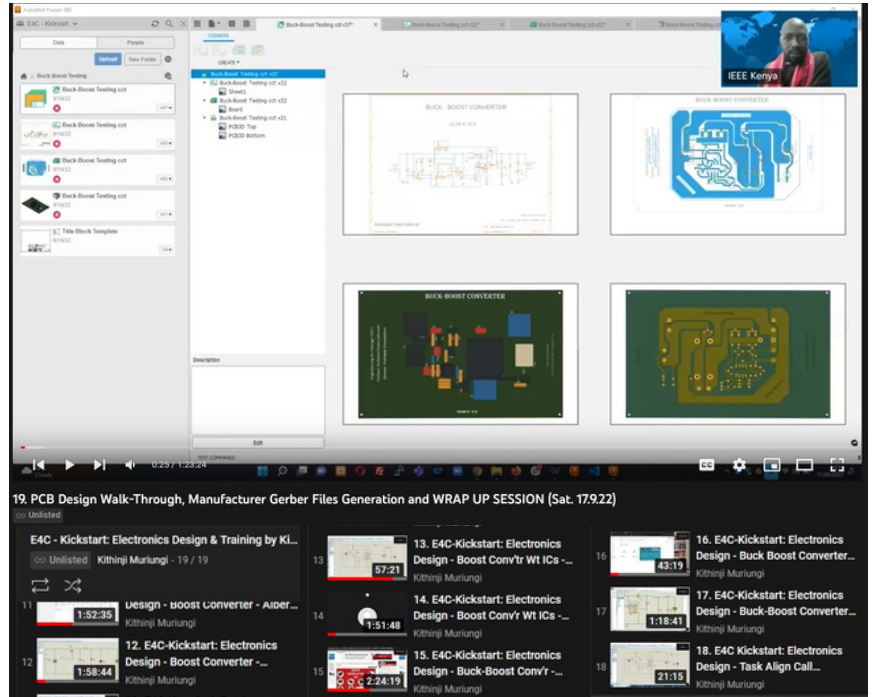
**Autodesk Foundation**

This work is in collaboration with:

**KickStart International**

Autodesk technology used in this project:

**Fusion 360 Electronics**



*Virtual Sessions recordings on YouTube*

The objective of this project was to give the KickStart International product design and development team the end-to-end understanding of the electronics design through a process workflow that can be adopted for future internal training. This is a significant skill set to the KickStart team as the organization looks into upgrading the manual pumps to solar-powered pumps. The project was implemented in Nairobi, Kenya where KickStart International's engineering and product intelligence center is situated. The project involved both physical and virtual engagement for a duration of five months with 5 team members from KickStart International.

The project scope included theoretical presentations and open-team discussions, hands-on practicals and demonstrations, individual and team circuit design exercises, and an industrial visit to an electronics manufacturing facility. The virtual sessions happened every week on Monday and Wednesday and 2 Saturdays per month which were divided into one virtual and one physical. The sessions ranged from 1 to 4 hours. Each session followed a step-by-step outline and all the sessions were recorded and shared on YouTube for future reference. The electronics design and training delivered content included: introduction to electronics engineering and

design; basic electronics circuit understanding and configurations; fundamentals of solar electronics systems; electronics circuit design and simulations tools (Autodesk Fusion 360 Electronics and Proteus) understanding circuit design workflows; individual and team basic circuit design (Buck, Boost, and Buck-Boost Converter); basic circuit assembly (breadboard and stripboard); PCB design; Manufacturer files generation (Gerber files); and electronics manufacturer industrial visit at Gearbox Europlacer.

The step-by-step build-up and iteration of the training material through regular feedback and customization based on the KickStart team's needs and use of both Autodesk Fusion 360 Electronics and Proteus brought a holistic delivery of both theory and hands-on learning. At the end of the project engagement, all the KickStart International design team members were able to understand the end-to-end process workflow involved in electronics design and development.

**Outcome:** Team capacity building in electronics design for solar-powered pumps



2 ZERO HUNGER



Rebound Technologies

# Icepoint Mechanical Vapor Recompression Compressor Aerodynamics Efficiency

Fellow: **Gabriel Ayú Prado**, Panama

Expert Fellow: **Harsh Vyas**, India

Partner collaborators: **Russell Goldfarbmuren**,  
Chief Technology Officer, USA

This work was supported by:

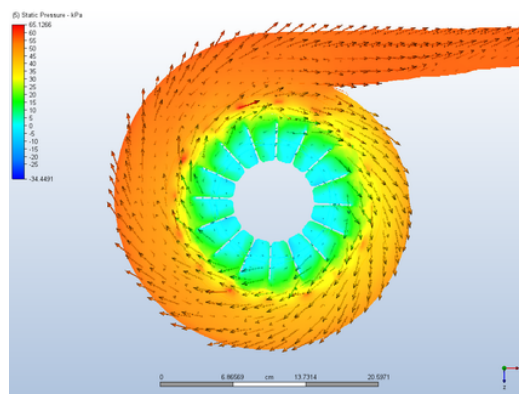
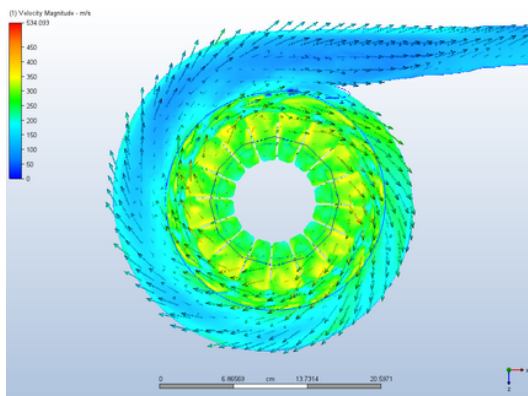
**Autodesk Foundation**

This work is in collaboration with:

**Rebound Technologies**

Autodesk technology used in this project:

**Autodesk CFD**



*Pressure buildup (top) and velocity profile (bottom) in a cross section view of the compressor*

This project provided Rebound Technologies with a computational fluid dynamics (CFD) simulation of the baseline aerodynamic performance of the compressor used in their Mechanical Vapor Recompression (MVR) system.

Rebound Technologies has performed lab tests to determine the operating ranges of the compressor being implemented in their MVR system, but this project aims to establish the theoretical performance of this compressor using the software package of Autodesk CFD and determine if improvements can be made to the design. The work focuses primarily on the current operating parameters being implemented in the system as well as the current volute and impeller geometry.

A geometry assembly file was constructed to be imported to the simulation environment. The current impeller and volute geometry were used as the basis to construct the domain geometry where the flow path was simulated. Research and trials were performed to determine the parameters, conditions, and flow material in the simulation environment that could ensure the highest fidelity and accuracy of the simulation with respect to the behavior of the real system.

A record was developed on how all these parameters may interact with one another and what considerations must be taken into account when applying them. A CFD model file was produced so that the partner organization can continue testing different conditions in the simulation environment.

Rebound Technologies aims to provide a new refrigeration technology that not only is able to provide more flexibility to end-users which can lead to massive reductions in energy consumption, but also to provide a system which doesn't require the use of potentially hazardous refrigerants used in traditional, industrial refrigeration systems such as ammonia. The improvement of the MVR compressor can lead to further improvements on the energy efficiency of the system.

**Outcome:** CFD model of Mechanical Vapor Recompression system for safer, more energy efficient, refrigeration

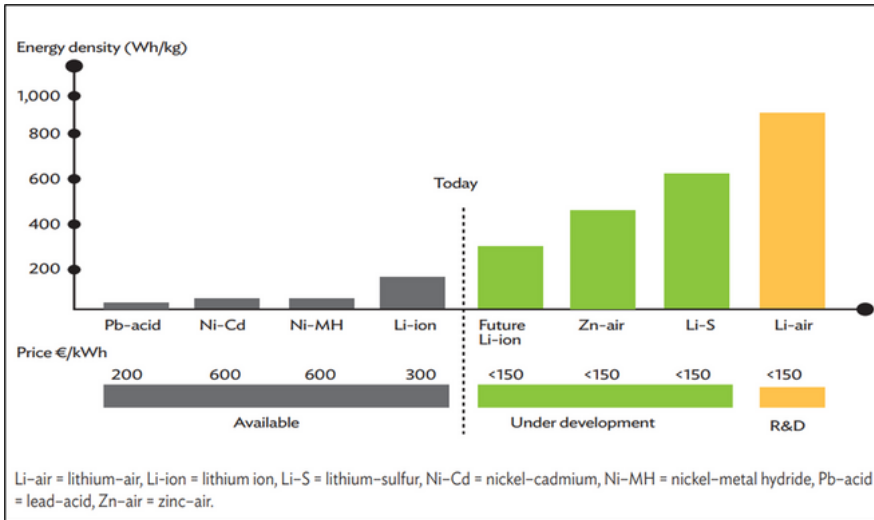
**Rebound**  
Technologies

**AUTODESK**  
FOUNDATION



# Build Health International Battery Solutions for Healthcare Facilities in Low Resource Settings

**Present and future battery technologies - energy density comparison**



Fellow: **Ibrahim Walaman-I**, Ghana

Expert Fellow: **Helen Lindsay**, USA

Partner collaborators:  
**Omar Hernández**, Sr. Dir. of Engineering and Construction, USA  
**Sarah Sceery**, Dir. of External Relations and Engagement, USA  
**Tyler Morris**, Project Manager, USA

This work was supported by:

[\*\*Autodesk Foundation\*\*](#)

This work is in collaboration with:

[\*\*Build Health International\*\*](#)

This research provides technical guidance in selecting an appropriate Battery Energy Storage System (BESS) to complement renewable energy (solar PV) integration in health facilities in resource-constrained settings.

The global challenge of quality healthcare provision, particularly in marginalized communities, and associated ramifications, such as alarming mortality rates, impede sustainable development. Build Health International (BHI) is committed to an equitable health future, providing infrastructure to deliver high-quality care that can be operated and maintained in resource-constrained settings, contributing to achieving SDG 3 (Good Health and Well-being). In pursuance of its mission, BHI, in collaboration with Engineering for Change (E4C), conducted research to present a cross-section of appropriate Battery Energy Storage Systems (BESS) to guide and inform decision makers within BHI on efficiently integrating renewable energy generation (solar PV) at health facilities in marginalized communities globally with unreliable or no access to grid electricity.

A detailed analysis of contemporary battery technologies compared technical details, merits and demerits, and ranked technologies, to guide in selecting a suitable battery technology.

Featured technologies included various types of Lead-Acid, Lithium-Ion, Nickel-Cadmium, Nickel-Metal Hydride, Sodium-Sulfur, and Redox Flow Batteries. Several emerging battery technologies were also highlighted for future consideration, including Zinc-Air, Lithium-Sulfur, Lithium-Air, Solid-State, Lead-Acid Carbon and Saltwater batteries. Based on interviews with battery manufacturers, industry professionals, and case studies, suitable commercially available batteries were suggested. Quantitative and qualitative data were distilled into a graphic, comparable framework to assist BHI in selecting the most suitable battery solution.

Electricity is vital in delivering quality healthcare. Clean electricity from solar PV, coupled with battery storage, is essential in reaching global sustainability targets: achieving a net-zero carbon emission future (SDG 7) and quality healthcare (SDG 3). This study contributes to sustainable development by assisting BHI in selecting clean energy storage solutions.

**Outcome:** Technical battery solutions for health facilities in resource-constrained settings



MASS Design Group

# Advancing the Practice of Fire Safety in Rwanda

## *Fire incident at Gisozi Modern Market, Kigali, Rwanda*



Fellow:

**Jane Gachuche**, Canada

Expert Fellow:

**Helen Lindsay**, USA

Partner collaborators:

**Tilly Lenartowicz**, Director, Building Services Engineer, Environmental Lead, Rwanda

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**MASS Design Group**

The objective of this project was to provide guidance for developing a contextualized framework to advance fire safety practices in Rwanda. It also proposes methods to raise awareness of fire safety engineering best practices amongst architects, designers and engineers. This research was conducted in collaboration with MASS Design Group, Engineering for Change (E4C) and Kindling, a non-for-profit organization for fire safety equality.

Over 95 percent of all fire deaths and injuries occur in low- and middle-income countries. Fire-related deaths in Africa alone are predicted to increase to an estimated one million deaths each year in 2050, in part due to rapid increases in population, urbanization and new technologies presenting new safety challenges. In Rwanda, there has been government recognition of the increase in fire incidence in the country. MASS Design Group, an international architecture firm, has sought to increase awareness and knowledge on fire safety engineering best practices for their projects in Rwanda and in doing so contribute to advancement of fire safety in the region.

Through desk research, design workshops and expert interviews, an analysis was conducted of the fire safety problem and risk profile in Rwanda, in

addition to a review of design, regulation and management capacities for construction projects. These guided the recommendations for the fire safety management framework and ways to increase understanding of the issues and the existing tools available to address them.

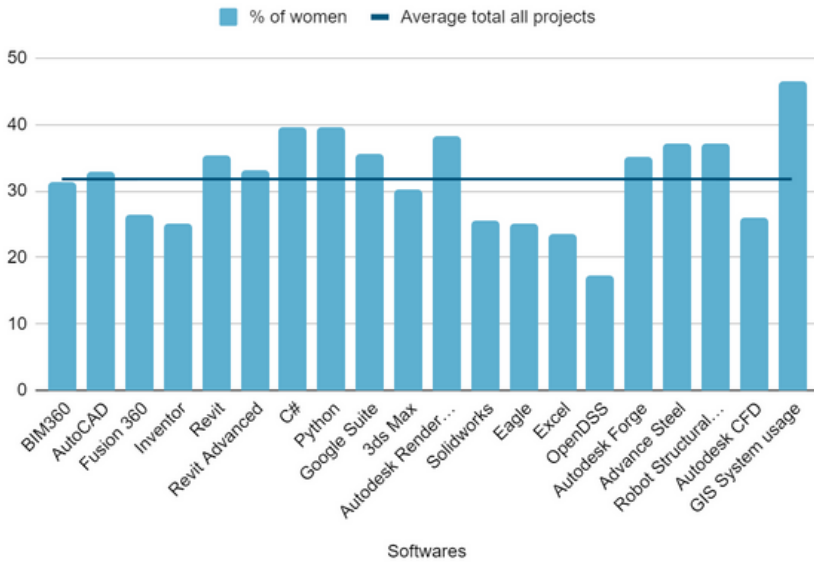
Developments proposed include ensuring multi-disciplinary collaboration throughout the design stages between architects, designers, fire safety engineers and consultants. Additionally, existing frameworks such as the Urban FRAME Diagnostic tool, which identifies gaps and opportunities for fire risk reduction, should be utilized at a local and national level to further assess the regulatory environment in Rwanda. As recommended in the research, tools like this can also be used to engage with stakeholders on strategies for evaluating the current situation and identifying areas for improvement and investment.

**Outcome:** Proposed improvements for fire safety practices in Rwanda





# Engineering for Change Advancing E4C Fellowship Program Workflows



**Average percentage of women applicants for projects requiring software**

Fellow:

**Maryam K. Ahmed, Egypt**

Partner collaborators:

**Erin Peiffer, Research Manager**

This work is in collaboration with:

**Engineering for Change**

Since 2014, the Engineering for Change (E4C) Fellowship Program has grown and evolved from supporting seven Fellows contributing primarily to the Solutions Library, to over 55 Fellows working on nearly 40 Impact Projects with partners in addition to adding to the Solutions Library in 2022. Additionally, for the Summer 2022 Fellowship alone, E4C received over 1,800 interested applicants. With this growth has come the need for scaling and improving current processes across the Fellowship. The objectives of this project were to support Engineering for Change with improving the efficiency of key programs, particularly advancing Fellowship program workflows. Specifically, this includes developing operation management templates, and automation of processes related to recruitment and other management processes.

As part of this work, the Fellow assisted in the creation of management templates to be used by the management team as well as the consolidation of Fellowship historical data in support of E4C’s impact tracking. Additional work included mapping the current recruitment process using Miro, indicating the individuals involved and the tasks required. New templates for recruitment were then developed with automation added throughout.

Of the over 1,800 applicants for the Summer 2022 Fellowship, only a third of those who applied were women. Although this percentage is nearly double the global average for women in engineering (INWED, 2022), as an organization that values diversity, equity, and inclusion, E4C was interested in understanding potential reasons for the low percentage of women applicants and ways that they can encourage more women to apply in the future. As such, a short study was conducted to analyze E4C’s applicant data by the project including skillset, education, and location requirements. While this analysis is ongoing, Figure 1 shows the breakdown of the average percentage of women applying to projects with specific software requirements.

**Outcome:** Improved workflows and application gender analysis to support gender equity in the E4C Fellowship Program





# Engineering for Change Longitudinal Study: Assessing E4C Fellowship Program Impact

Fellows:

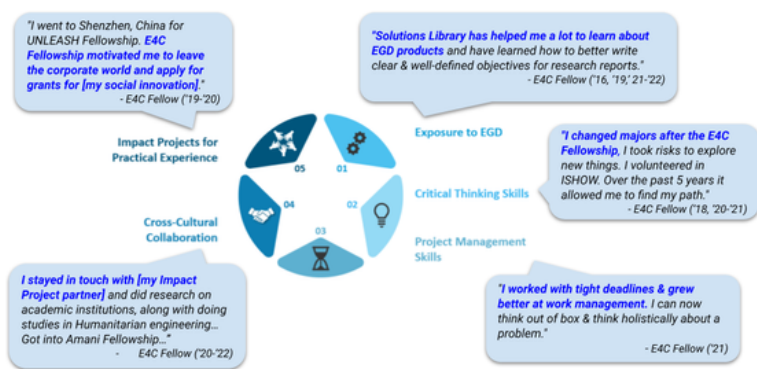
**Ana Milena Trujillo Castro**, Colombia  
**Arijit Goswami**, India

Expert Fellow:

**Sahar Shamsi**, Canada

Partner collaborators:

**Laura Maher**, Head of External Engagement,  
Program Manager, Siegel Family Endowment, USA  
**Erin Peiffer**, Research Manager, Engineering for  
Change, USA



This work was supported by:

**Siegel Family Endowment**

This work is in collaboration with:

**Engineering for Change**

## Impact of E4C Fellowship on Alumni

E4C's Fellowship Program offers fellows a unique opportunity to learn new technical and professional skills through Impact Projects with partner organizations, attend 30+ hours of curated Learning Modules, gain exposure to multidisciplinary (physical, social, digital) infrastructure frameworks, and gain access to a vast network of experts and alumni. However, programs are prone to becoming outdated if they are not revamped regularly through continuous improvements – both incremental and large. Therefore, it was imperative for E4C to investigate the strengths, gaps and opportunities for improvement that could make the fellowship program more impactful.

The goal of this project was to implement E4C's Fellowship Program Impact Evaluation Strategy to assess impact, capture concrete examples of how Fellows are exposed to multidisciplinary infrastructure, and provide recommendations and actionable insights on ways to improve the program and their Impact Evaluation Strategy.

Through a variety of tools (e.g., surveys, rubrics, interviews), results show that overall the vast majority of Fellows from the 2022 E4C Fellowship program (Summer Cohort) and partners were satisfied with their experience. Additionally, current Fellows indicated an average increase in their confidence in global professional and technical skills. Interviews with alumni highlighted how the fellowship influenced their career progressions.

Current fellows and alumni (n = 14) provided feedback on how the program can be improved including rearranging when certain training is offered, revamping the Learning Module curriculum, and how to strengthen the alumni network. Additional recommendations for improving E4C's Impact Evaluation Strategy were provided based on desk research on evaluation models and interviews with other US-based workforce development organizations.

**Outcome:** Impact evaluation of E4C Fellowship Program



JFF Labs

# State of Data Capacity, Capability, and Maturity of Education & Workforce Institutions

## Exploring the US non-profit educational organization landscape at a glance



### Challenge

Making use of the data collected over the years, and making decisions based on the data is a challenge most education organisations and workforce boards are facing in the US. This is due to a staffing issue caused by budgetary limitations, combined with the lack of data literacy across all levels of the organisation.



### Opportunity

Nurturing data professionals in the organisation can go a long way into improving data driven decision making across all levels of the organisation. Most organisations are planning to improve their current state of data maturity over the next 5 years.



### Potential

There is a potential for symbiotic partnerships between these non-profits looking to upscale their data capacity, and the data service providers. Many non-profits don't have the resources to have in-house data professionals but are investing into having vendor partnerships to upscale their data maturity in the coming years.

This work was supported by: [Autodesk Foundation](#)

This work is in collaboration with: [JFF Labs](#)

Fellow:

**Arya Sarkar, India**

Expert Fellow:

**Martín Ignacio del Pino, Argentina**

Partner collaborators:

**Eshwar Eshwaran, Director LABS LEAD, USA**

**Faye Ackeret, UX/Product Lead, USA**

The objective of this project was to support JFF Labs in assessing the state of data capacity, capability, and maturity of education and workforce institutions across segments of the industry. From this research, including desk research and interviews with subject matter experts and industry stakeholders, it was found that post-pandemic, every organization is trying to up their data game, as they have become aware of the value of digital medium and data in general. From collecting, to storing and analyzing data has been a major challenge given the limited resources for most non-profit education organizations and workforce boards.

The major challenges faced by these non-profits is a severe shortage of staff, capable of utilizing the data they are collecting. Most of the smaller nonprofits do not have even one dedicated person capable of utilizing the data they collect. This is not because of a lack of awareness, but due to lack of funds that can be invested to improve the data infrastructure. Medium sized organizations generally have 1-2 dedicated people in the data team and use more than Excel. We found that these organizations use Tableau, Power BI and other tools to even make interactive dashboards. Finally larger non-profits which have been functional for many years have overcome staffing challenges and have dedicated data teams, capable of making vital organizational decisions based on previous data. The large non-profits however are not free of all problems, they are

suffering from a problem of tackling data security owing to their massive data warehouses.

Another challenge that organizations irrespective of their size are dealing with, is adapting to the post-pandemic world where the majority of the things which were previously done physically have been automated with ease, virtually. To combat this challenge, many of the non-profits we talked to are investing in training existing employees who specialize in a completely different skillset to adapt and get used to operating virtually.

Now that most organizations have started getting used to the post-pandemic changes, the next few years look much better for data maturity as most organizations (irrespective of their size) we talked to, are certain that they would only upscale their investments into improving their data capacity and literacy going forward and try to solve the challenges they are facing in the process. This creates a major opportunity for data service providers, to come in as vendors and aid in the improvement of the data maturity and literacy at these organizations.

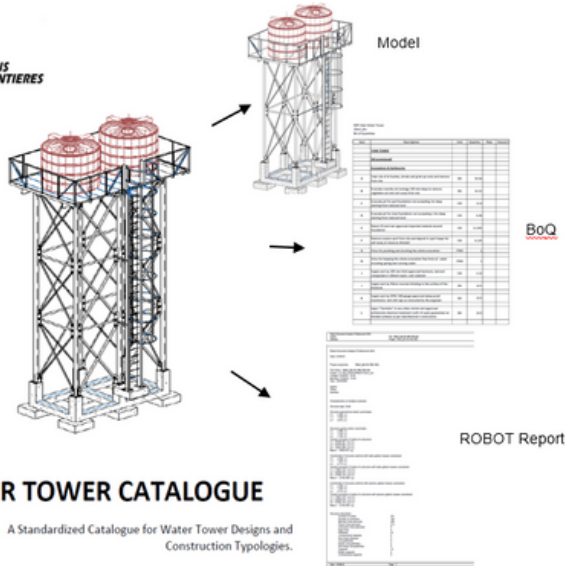
**Outcome:** Landscape analysis of data capacity, capability, and maturity of education and workforce institutions





Médecins Sans Frontières

# A Standard, Adaptable Catalogue of Water Tower Designs and Construction Typologies



## WATER TOWER CATALOGUE

A Standardized Catalogue for Water Tower Designs and Construction Typologies.

### MSF Water Tower Catalogue Cover Page and Sample Contents

Fellow:

**Hamisa Rizgallah, Kenya**

Expert Fellow:

**Nicolas Kalimba Rugamba, Rwanda**

Partner collaborators:

**Paul Cabrera, MSF OCBA Construction & Shelter Advisor, Italy**

**Benedict Waters, MSF Structural Engineer, Canada**

**Simone Primosich, MSF Structural Engineer, Italy**

This work is in collaboration with:

**Médecins Sans Frontières**

Autodesk technology used in this project:

**Revit, Robot Structural Analysis, Dynamo, and Advanced Steel**

Médecins Sans Frontières (MSF), also referred to as Doctors Without Borders, is an autonomous, international humanitarian organization that offers medical aid to those in need. Due to the nature of their work, access to dependable and clean water is necessary for their various programs to run effectively, hence well-constructed and maintained Water Towers are pivotal. This project served to lessen the gap between the inception of MSF's programs and their execution by providing readily available and adaptable models of Water Towers that can be easily implemented upon approval and or modification by an Engineer in the area where the program will be implemented.

Being a continuation of the E4C 2021 Fellowship project, this phase of the project aimed to firstly validate all the models to the Kenya Building Code (KS Code) since this code is comparable to those of the regions of implementation within Sub-Saharan Africa and there after produce detailed drawings of the already designed models in order to make fabrication and construction much easier, produce Bills of Quantities of all models for easy costing for the MSF

team as well as the contactors and also produce Robot Structural Analysis reports to be consulted by the Engineers on site when necessary.

The PDF packet produced by this project lays the foundation upon which other models will be produced catering to different steel sections such as H beams and circular columns as well as different materials like concrete and also different risk categories such as earthquake prone zones or weak bearing capacity soils.

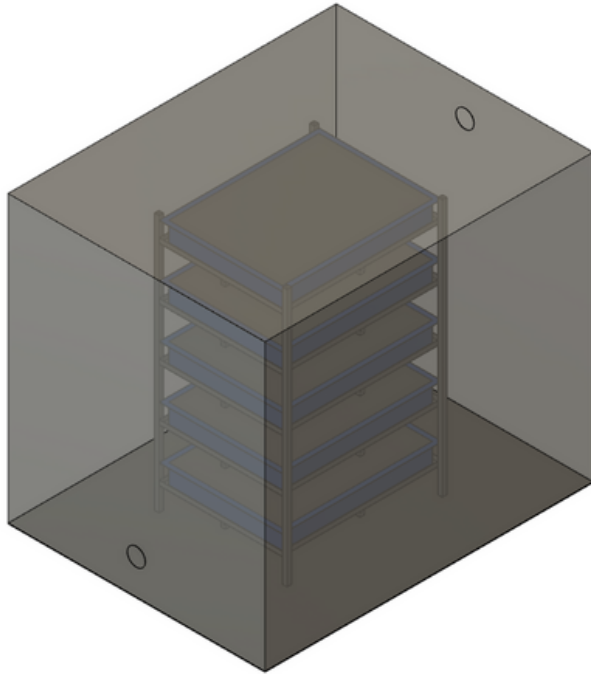
**Outcome:** Water tower designs for easier implementation in areas of need





Fresh Life

# A Breath of Fresh Air 2.0: Optimizing Sustainable Protein Production from Waste



**Respiration chamber and larvae bed arrangement in greenhouse**

Fellow:

**Isaac Charles Kimani Njoroge, Kenya**

Expert Fellow: **Harsh Vyas, India**

Partner collaborators:

**Pavan Kumar, India**

**Evans Meme, Kenya**

**Gordy Zak, USA**

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**Fresh Life**

Autodesk technology used in this project:

**Fusion 360 and Autodesk CFD**

Fresh Life is a circular economy company which focuses on the conversion of organic waste (such as sewer waste and plant waste) into organic fertilizer, briquettes, and insect-based animal feeds. The project goal was to improve airflow control (temperature and humidity) of the black soldier fly (BSF) larvae production greenhouse by evaluating and optimizing the current design.

Conversion of the organic waste into useful end products is achieved through the use of BSF larvae. In order to ensure that the yield of the BSF larvae is maximized, the rearing of the larvae is done in greenhouses, where conditions such as temperature and relative humidity can be controlled. Airflow and circulation inside the greenhouse (macro climate) and in the bed region (micro climate) has a significant effect on BSF yield. Adequate fresh air has to be supplied into the greenhouse and bed region to ensure that there is no build up of Ammonia and CO<sub>2</sub> and also to make sure that temperatures are maintained within an acceptable operational range.

Design concepts were modeled in Autodesk Fusion 360 and Autodesk CFD used to evaluate the air circulation. The computational domain used in the CFD analysis was modeled to mirror real-world

operating conditions in the greenhouses. A weighted selection matrix was then utilized to select the final design concept based on factors such as CAPEX, OPEX, ease of fabrication and installation as well as performance. The final design concept selected provides a significant improvement in airflow and circulation in the bed region; promoting aeration, as well as better temperature and humidity control. These improvements in the microclimate would provide conducive conditions for larvae growth thus resulting in increased yield (in relation to larvae body mass) by the end of the growth cycle.

The final design concept which was selected based on the CAD and CFD work carried out in this phase of the project will be fabricated and experimental pre-feasibility trials conducted in a specially designed respiration chamber at Fresh Life. In addition to this, the selected design concept will provide the basis for further CFD modeling for the full-scale greenhouse.

**Outcome:** Improved design to maximize larvae growth



# Splash Social Enterprises Product Engineering Support for Handwashing Station for Covid-19 Response

## V1 handwashing station designed Source: Splash



Fellow:

**Eleazar Archer**, Ghana

Expert Fellow:

**Helen Lindsay**, USA

Partner collaborators:

**Linzi Lee-Blodgett**,

Project Manager, Splash  
Social Enterprise, USA

**Alec Wollen**, Technical

Lead, PATH, USA

**Jason Yu**, Manufacturing  
Representative, E-Bi, USA

This work was supported by: [Autodesk Foundation](#)

This work is in collaboration with: [Splash](#)

Easy and reliable access to clean running water is critical for controlling the spread of viruses, especially in high-risk areas like hospitals and schools. Handwashing stations are clean water access points for hygiene enhancement in disease control. With the onset of the Covid-19 pandemic, the need arose for low-cost hand washing solutions for schools and health facilities in underserved communities to curb the spread of the disease among the most vulnerable. The design needed to discourage hand contact, encourage social distancing, be easy to use, and provide uninterrupted washing for at least a day at low cost.

To address the need for an easy-to-use, contactless, and reliable hand washing solution, insights on the factors that could make successful and effective handwashing stations were gathered from a field survey and review of literature on controlling the spread of the Covid-19 pandemic and other water borne-related diseases to a first handwashing station. The first version (V1) of Splash's handwashing station prototype was deployed to study its field performance and failures in November 2021.

The pilot program led to a redesign increasing the number of stations from two to three while sloping

the ends of the station to provide more shoulder-to-shoulder spacing to minimize bottlenecks at washing stations. Also, most features on the washing station were redesigned to be tamper-proof.

Extensive work also went into benchmarking and documenting the handwashing station design to serve as a reference for future development, with an objective testing plan to verify the performance metrics. The new station design was complete and is in the final stages of preparations for low-volume manufacturing. Bill of Materials, assembly drawings, installation and user manuals, and testing plan documentation have also been made to aid the verification and implementation of the new design.

The new handwashing station is expected to help build positive handwashing behaviors, especially among children, to curb the spread of the Covid-19 pandemic and minimize the occurrence of hygiene-related diseases in its implementation locations.

**Outcome:** Improved handwashing station design





UNHCR

# UNHCR WASH Design Details Library



*School children using a solar powered water point rehabilitated by UNHCR in Adagom community, Ogoja, Cross River State.*

**Credit:** © UNHCR/Roland Schönbauer, Nigeria, 2022

Fellow: **Catherine McManus**, USA

Expert Fellow: **Helen Lindsay**, USA

Partner collaborators:

**Emmett Kearney**, Sr. Global WASH Officer, Switzerland

**Anne Hyvärinen**, Associate WASH Officer, Switzerland

**Jill Lauren Hass**, former WASH Officer, Canada

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**UNHCR The UN Refugee Agency**

Autodesk technology used in this project:

**AutoCAD**

This impact project resulted in the digitization and improved functionality of the UNHCR's WASH (water, sanitation, and hygiene) design details library, which consists of detail drawings and preliminary bills of quantities (BOQs) used in constructing essential infrastructure.

The Technical Support Section of UNHCR provides technical support and guidance to field officers working in UNHCR implementation contexts (such as refugee camps). Part of this support is a library of standard WASH details which are intended to be adapted for site-specific design and construction.

This impact project involved developing templates for WASH details and preliminary BOQs and adapting the pre-existing library to those templates, focusing on consistency and modifiability of all documents. Special attention was paid to ensuring that technical and non-technical UNHCR staff could interpret and use these documents. References to guidance texts and referrals to specialists were included with the documents. Feedback from field engineers was incorporated into the final library package.

Next steps will involve more iterations of feedback from non-technical team members and subject matter experts and the inclusion of context-specific alternative materials and methods. The improved WASH details library will contribute to the efficient and safe implementation of WASH infrastructure in refugee camps.

The library is free and available online at <https://wash.unhcr.org/wash-technical-designs/>

**Outcome:** Digitalization and improved functionality of WASH design details library for refugee camps

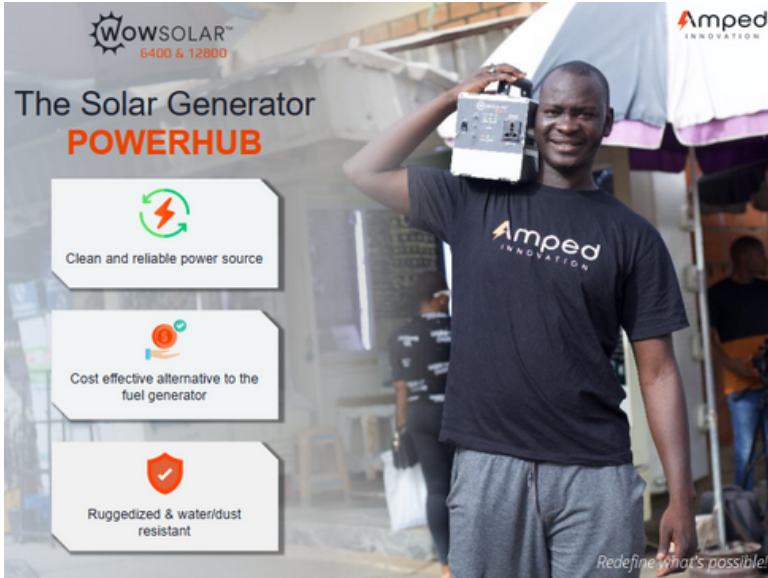


**UNHCR**  
The UN Refugee Agency





# Amped Innovation Gaining Customer Acceptance of PV-Based Inverters in Nigeria



**Amped Innovation's Solar Generator Powerhub**  
Credit: Amped Innovation

Fellow: **Alex Inoma Olisa**, Nigeria

Expert Fellow:

**Martin Ignacio del Pino**, Argentina

Partner collaborators:

**Kurt Kulhman**, Co-CEO, USA

**Andi Kleissner**, Co-CEO, USA

**Nicholas Maina**, VP of Sales, Kenya

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**Amped Innovation**

Autodesk technology used in this project:  
**Fusion 360**

Unreliable electricity supply has continued to prevail as a major challenge in Nigeria and several developing nations. This has led to the adoption of fossil fuel-based backup generators as an alternative source of electricity. The use of these generators is not only dangerous to the environment but typically costly to acquire and maintain. Some reports have estimated that Nigeria spends about three times what it does on the grid on backup generators. The effect of this is a strain on businesses and households to afford the much-needed electricity supply.

Amped innovation, to solve the energy crisis and reduce the reliance on fossil fuel generators, developed the PowerHub. The PowerHub (also referred to as a solar generator), has the goal of utilizing solar energy to provide electricity access to millions of business owners in Nigeria at a cost well below that of the fuel based generators while utilizing the flexible “pay as you go” model. To gain customer acceptance for the PowerHub in Nigeria, Amped Innovation partnered with Engineering for Change. This involved acquiring an “on-the-ground” understanding of the solar energy landscape in Nigeria and identifying the pain points of the customers and distributors.

The project approach began with qualitative interviews across several stakeholders along the value-chain who served as key informants for their group. The interviewees were primarily distributors of solar products and small business owners requiring regular electricity. They answered questions on the energy challenges faced in Nigeria, the cost burden of the fuel generator, and their perspective towards solar energy products. Distributors, in particular, were given a glimpse of the specification sheet for the PowerHub from which they highlighted the specifications that they prioritized and identifying areas of improvement for better representation of the product.

Following the synthesis of the interviews and taking into consideration the key takeaways, a specification booklet was developed for the PowerHub. This revised specification document was scrutinized by distributors of solar products in the second round of interviews and the feedback was effected in the design of the final document. Alongside this specification booklet, was also developed a sell-sheet which will be used to communicate the PowerHub with potential customers.

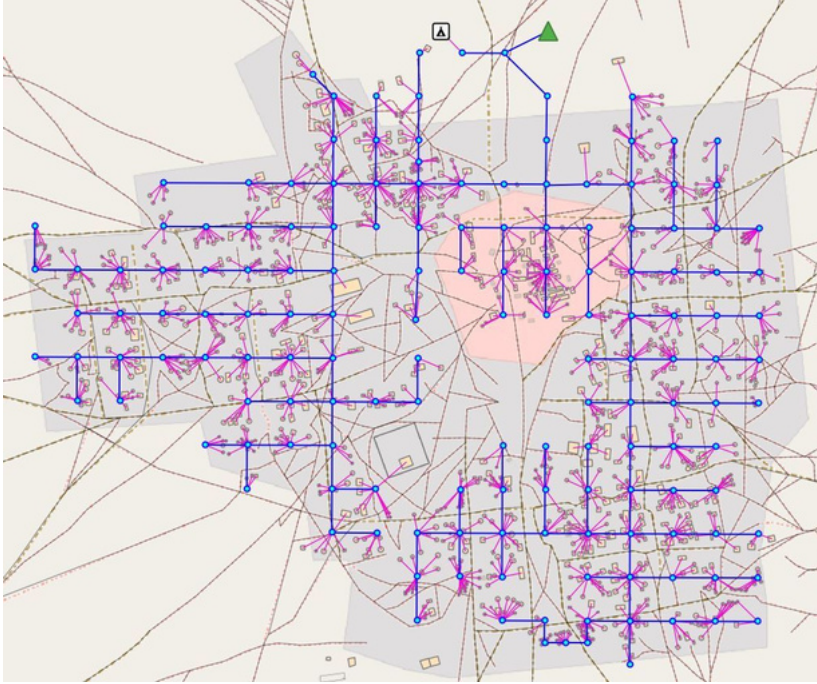
**Outcome:** Increased customer acceptance of solar energy solutions





Arizona State University

# Power System Modelling and Analysis for Rapid Mini-Grid Assessment Process



*Example of a QGIS Designed Mini-Grid in West-Africa*

Fellows:

**Brighton Ombuki**, Kenya

**Eric Bidong**, Democratic Republic of  
Congo

Expert Fellow:

**Paulo Vela**, Peru

Partner collaborators:

**Dr. Nathan Johnson**, Director Laboratory  
for Energy and Power Solutions - LEAPS,  
USA

**Elena Van Hove**, Director of Global  
Energy Access - LEAPS, USA

This work is in collaboration with:

**Laboratory for Energy and Power  
Solutions, Arizona State University**

Across the globe, especially in developing countries, the majority of the population lack access to electricity or have inadequate access that is often unreliable, unsafe, and/or unaffordable. Also, due to the need to mitigate climate change, there is a significant commitment toward the adoption of clean and sustainable sources of energy for electrification efforts.

This project aimed to optimize the current processes employed by Arizona State University's Laboratory for Energy and Power Solutions (LEAPS) in the rapid design and implementation of mini- and micro-grids. The current process incorporates the use of power engineering, machine learning, and geospatial information systems to remotely conduct feasibility assessments of mini-grids for unelectrified rural communities globally.

In this project, we proposed the optimization of the mini-grid design process through the adoption of a PostgreSQL database. The adoption of this database is expected to reduce the time taken in the design of the grids. We also developed guides on the use of various power system analysis tools to aid in the analysis of designed mini-grids. Overall, the current process is projected to improve mini-grid project estimates by over 60% and speed up the scoping process for mini- and micro-grids by over 90%.

**Outcome:** Improved processes and efficiencies of mini-grid design



M2X Energy

# Design of Transportation and Storage System in Modular Gas to Methanol Plant

Fellow: **Jorge Bravo**, Ecuador

Expert Fellow: **Kyla Strickler**, USA

Partner collaborators:

**Dr. Josh Browne**, CTO, USA

**Dr. Anthony Dean**, COO, USA

**Dr. Paul Yelvington**, CSO, USA

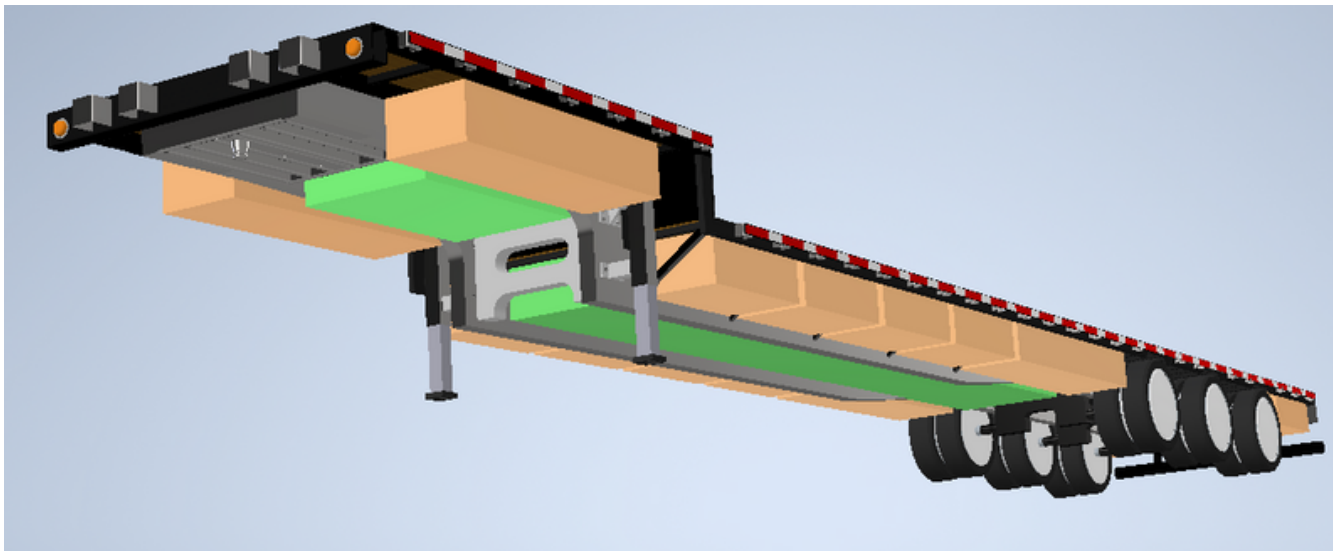
**Kyle Mercial**, Principal Engineer, USA

This work was supported by: **Autodesk Foundation**

This work is in collaboration with: **M2X Energy**

Autodesk technology used in this project:

**Inventor, Navisworks, and AutoCAD**



*Rendering of the trailer and storage volumes*

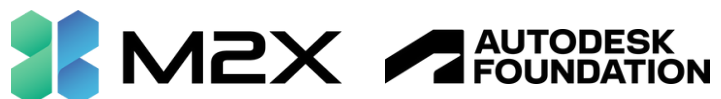
Gas flaring is the burning of natural gas associated with oil extraction and is a prominent source of VOCs, CO, CO<sub>2</sub>, SO<sub>2</sub>, PAH, NO<sub>x</sub> and soot (black carbon), all of which are important pollutants which interact, directly and indirectly, in the Earth's climatic processes. One way to mitigate its impact is to reuse the gas to produce methanol, which can be used as an alternative fuel source.

M2X Energy's main goal with this project is to increase access to clean, affordable energy in remote areas. For that purpose they are designing a modular plant system that can be transported on a trailer unit and maintained on site without special equipment required. This project elaborated a detailed CAD design of a trailer and analyzed the use of storage units underneath it to support M2X Energy's ongoing design process. The main objective of the project was to contribute to the decision-making process regarding the transportability and

maintainability of the modular skid so that it could become an integral design and the construction process could begin. The next steps would be to provide a weight distribution assessment of all the equipment on the trailer, and also find ways to optimize weight considering different setups and materials.

The Autodesk Foundation has sponsored the project by facilitating training and tools for CAD and rendering of the components of the plant. Inventor was majorly used, but Navisworks and AutoCAD were also part of the process.

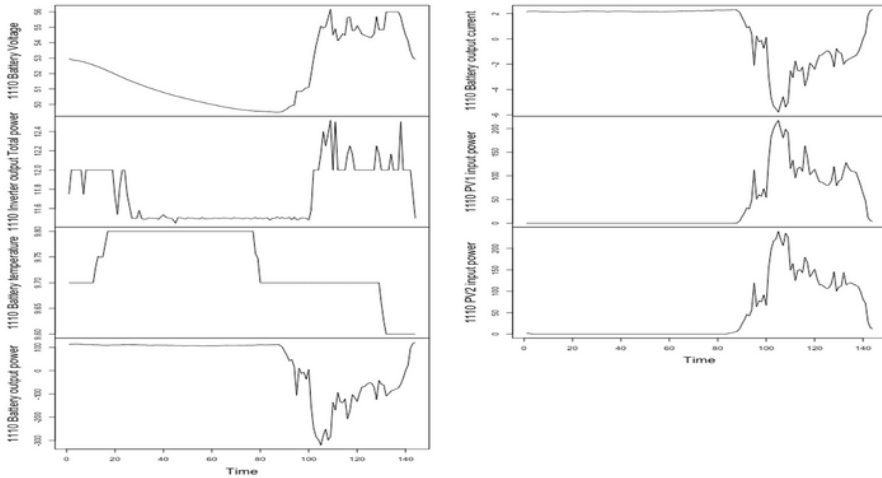
**Outcomes:** Design development of modular system for methanol plant





Seattle University and Navajo Technical University

# Analyzing Battery Voltage Profiles of Off-Grid Power Systems on Tribal Lands



*Time series plot for battery voltage and other supplementary variables*

This work was sponsored by: [Siegel Family Endowment](#)

This work is in collaboration with: [Seattle University](#) and [Navajo Technical University](#)

Fellow:

**Mohammed Ba-Aoum**, Saudi Arabia

Expert Fellow:

**Kyla Strickler**, USA

Partner collaborators:

**Dr. Henry Louie**, Director of the Humanitarian Engineering Applications Lab, USA

Energy poverty impacts over one billion people worldwide, which can have serious consequences on their health, education and economic life. Off-grid electrification could serve in addressing this problem. Tribal utilities and other organizations have made small solar-powered systems available to provide modest but critical access to electricity for Native American reservations. However, there is little data on how the systems perform after they have been installed; this critical information is required to improve designs, lower costs, and better meet user needs.

This project addresses this issue by developing and analyzing a new dataset of field measurements collected from approximately 200 off-grid systems on Native American reservations. The methods used include desk research, data analytics, and time series and statistical analyses. The software used in this project is R-Studio. The main variable of interest in this research was battery voltage while other supplementary variables used in the analysis include battery temperature, power output, inverter power, battery input current, and photovoltaic array power.

The developed method analyzed battery voltage levels to determine what time of day the voltage reached the charge controller's absorption level set-point—indicating the battery is almost fully charged. The earlier in the day this level was achieved, the more likely it is that the solar array could support additional electricity usage by the home. The findings of this project supports the important societal goal of increasing electricity access among underserved populations.

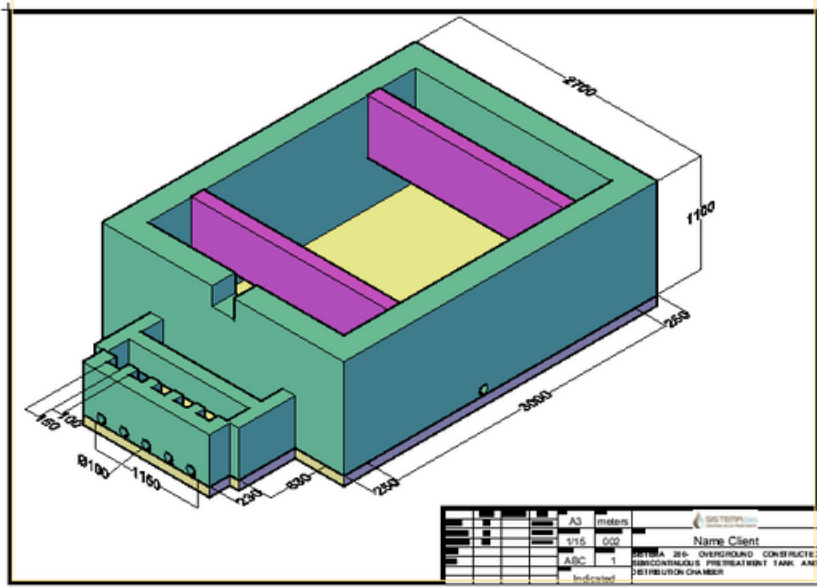
**Outcome:** Analysis of the performance of off-grid solar systems on tribal lands





Sistema.bio

# From Waste to Energy: Standardizing the Work-Stream of Biodigester Solutions



**Rendered Overground constructed semicontinuous pretreatment tank and distribution chamber for S200**

Fellow:

**Frida Korir**, Kenya

Expert Fellow:

**Julio Diarte**, Paraguay

Partner collaborators:

**Maxence Affre**, Global Technical Director, Kenya

**Vipin Kale**, Tech Manager, India

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**Sistema.bio**

Autodesk technology used in this project:

**AutoCAD**

Sistema.bio empowers farmers to sustainably convert farm and animal waste into energy. This project was aimed at standardizing designs and drawings of the Sistema.bio biodigester to improve work streams and quality of workmanship. Farmers can improve their productivity and farm output with the biofertilizer produced by the biodigester and burn biogas for cooking and energy, reducing reliance on biomass or LPG. The biodigester is a low-maintenance solution that offers long-term benefits. Quality of life has improved for farmers as they can now use biogas, an environmentally-friendly source of energy, to prepare meals.

With Sistema.bio expanding to Kenya, India, Mexico and Colombia, new challenges arose. Different farmers' needs must be catered for uniformly to maintain organizational standards. Initially, the Sistema.bio team created design drawings for the biodestor that varied based on different contexts. To remedy this, Engineering For Change came up with universal designs suitable for use globally.

A layer-based approach was used to enable different teams to quickly customize and scale accordingly. As a result, Sistema.bio has become more efficient in delivery.

Teams are now able to obtain customizable drawings and designs from the repository created. This has enabled ease in supervision and monitoring of works, and in general, better workmanship and durable infrastructure which go a long way in ensuring that the client gets value for money.

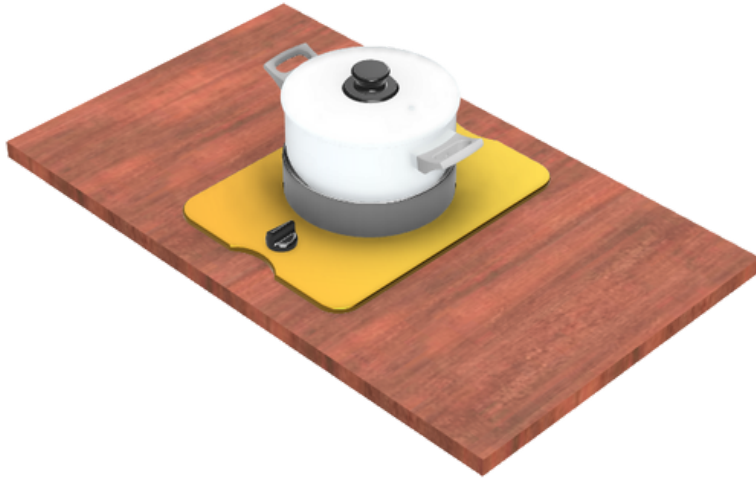
**Outcome:** Increased efficiency in workstreams of biodigester designs





Sunvine Africa

# The Design of an LPG Tabletop Gas Burner for Rural Kenya: The JuaJiko



*The JuaJiko: a unique, low-cost, durable LPG cooker with favorable thermal efficiency and energy-harvesting capabilities.*

Fellow: **Sydney Okoroafor**, Nigeria

Expert Fellow: **Harsh Vyas**, India

Partner collaborators:

**Isaac Kiragu**, CEO, Kenya

**Esther Mburu**, Technical lead, Kenya

**Lilian Maina** Customer relations, Kenya

**Julius Karungi** Mechanical Engineer, Kenya

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**Sunvine Africa**

Autodesk technology used in this project:

**Fusion 360**

More than  $\frac{3}{4}$  of rural Kenyans burn biomass for cooking. This inspired Sunvine Africa, a clean energy start-up, to work on clean cookstoves, particularly LPG tabletops and cylinders as a means of combating climate change by providing innovative energy solutions to the rural and off-grid communities in Kenya. The Sunvine gas tabletop - "The JuaJiko" is designed to be a low-cost, durable, unique LPG tabletop burner with favorable thermal efficiency and energy-harvesting capabilities.

We began with an extensive product benchmarking exercise, broke down our design into modular components and then began to research and ideate on each component. We proposed unique, low-cost, sustainable, and efficient designs for each component while leaving room for future innovation on each component. We settled on an infrared burner for the burner assembly along with its controls. For the enclosure (housing) we developed four major concepts made from interlocking plates, composite materials and clay/ceramic materials in varying configurations.

For our energy-harvesting capabilities, we designed the "Sun Ring" to capture residual energy in a particularly important heat zone. The "Sun Ring" is a promising product that can work with various third-party cookstoves, but it still needs extensive product development and testing.

We did a study for the rural population in Kenya where we aim to evaluate our prototypes and conducted interviews with important stakeholders to support our user-centered design approach, our judgments, and assumptions. The comments we received improved our decision-making, enabled us to improve the concepts, and helped us choose two enclosure concepts to move on to the prototype step.

The Sunvine gas tabletop - "The JuaJiko," is an inclusive product designed for developing countries will help in the fight against climate change by providing affordable, dependable equipment that uses clean fuel and gives off extremely low emissions. It would also help to improve public health by reducing respiratory diseases from unclean cookstoves. Additionally, the "Sun Ring", a thermal energy harvesting product compatible with other cookstoves, seeks to expand the value proposition Sunvine can offer its users.

**Outcome:** Design of LPG tabletop cooker for rural Kenya



ASME

# Supporting the Development of ASME's FutureME Labor Market Intelligence Tool

Fellows:

**Chris Mabey, USA**

**Himanshu Panday, India**

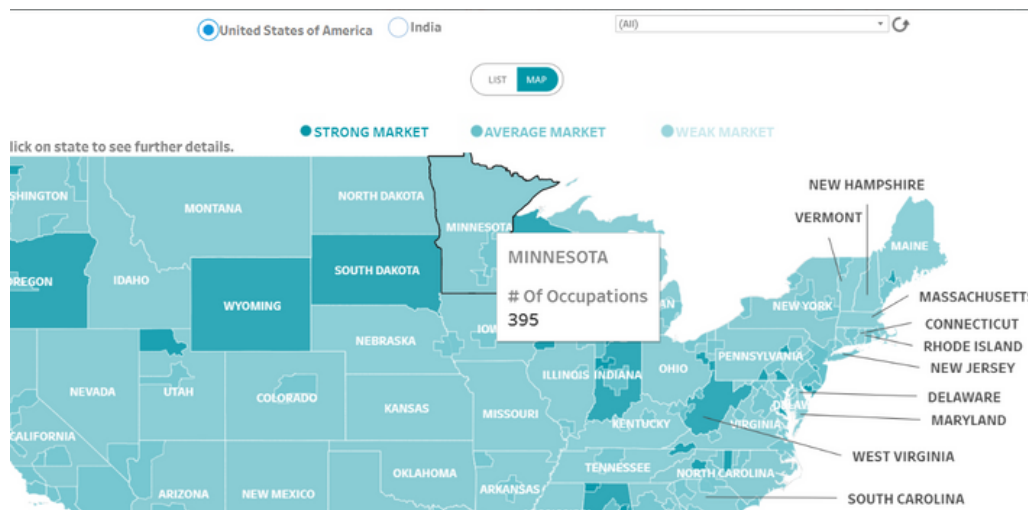
**Joseph Mdumuka, Malawi**

Partner collaborators:

**Nida Ahmed, Program Manager, EFX, USA**

**Serosh Shahid, Director, USA**

This work is in collaboration with: **ASME**



**Labor Market Intelligence Map**

The ASME FutureME community provides resources and support to early career engineers to ensure their success. The FutureME Labor Market Intelligence Tool allows engineers to explore career opportunities by region to map out their career trajectories and gather market insights based on occupation, salary, and more.

Fellows supported in the development of the tool by identifying datasets for employment (labor market insights) in India as well as exploring potential career roadmaps for mechanical engineers in the United States and India.

Fellows used automatic data sourcing, validation, and cleanup to compile the employment datasets. Additionally, a subset of career pathways were mapped to identify trends in career progression. Interviews were then carried out with engineering professionals to further explore career milestones and the skills necessary for navigating various career paths.

**Outcome:** Development of tool for engineers to map out their career trajectories



ASME Idea Lab

# Supporting ISHOW Idea Lab: Methodologies for Benchmarking Startups

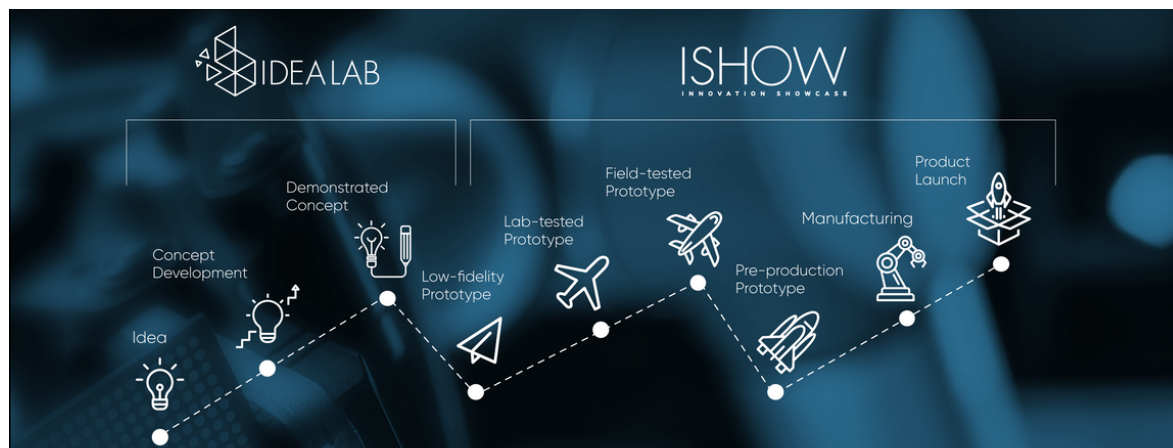
Fellow:

**Katerina Prokopiou**, Cyprus

Expert Fellow:

**Paulo Vela**, Peru

Partner collaborators:

**James Creel**, Senior Program Manager, USA**Adam Horbinski**, Senior Product Designer, USAThis work is in collaboration with: **ASME Idea Lab**

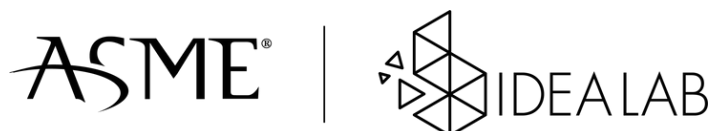
**With the Launch of Idea Lab, ASME will be supporting the Full Spectrum of Tech Development**

The American Society of Mechanical Engineers (ASME) Foundation mission is to support and promote hardware innovations that tackle global challenges. One of the Foundation's initiatives is the ASME ISHOW, an accelerator of hardware-led social innovation. Since its launch in 2015, the accelerator has supported more than 200 hardware ventures to develop their prototypes into a market-ready solution.

As the accelerator developed, a gap was identified in early stage idea innovations. Applicants to the ISHOW accelerator did not have a prototype but had promising solutions. In order to provide guidance to hardware innovations at these early stages, ASME ISHOW has launched Idea Lab. Idea Lab is a new initiative to guide aspiring social entrepreneurs through the design process, from problem statement to low-fidelity prototype. Idea Lab acts as an incubator and provides mentorship, seed capital, resources, tools and space to aspiring social entrepreneurs with an innovative and impactful idea, concept, or developed concept who have not yet created a first iteration prototype.

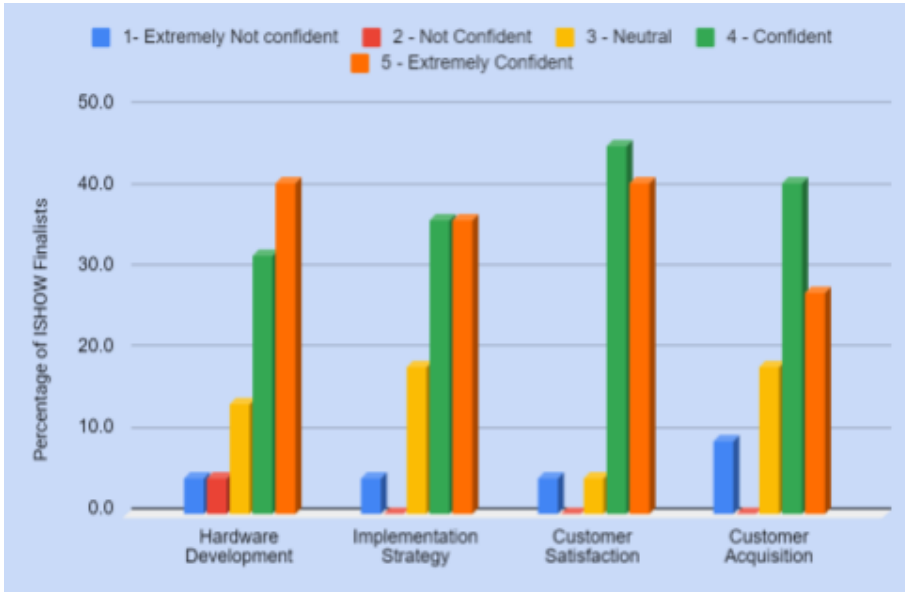
This project focused on the design and implementation of the application selection process for Idea Lab, using insights from existing incubators. With a long term vision, the selection process includes factors such as, hardware production feasibility, potential social impact, as well as future investment attraction. A layered approach also meant that at each stage of the review process, different levels of expertise were utilized in order to make an informed decision on the selection of applicants.

**Outcome:** Methodology for the selection process of Idea Lab applicants





# ASME ISHOW Longitudinal Study on Social Return on Investment



**Preliminary survey results from past ISHOW finalists indicated how much more confident they feel since participating in ISHOW**

Fellow:

**Tanvir Khorajiya**, India

**Erion Bwambale**, Uganda

Expert Fellow:

**Paulo Vela**, Peru

Partner collaborators:

**James Creel**, Senior

Program Manager, USA

This work is in collaboration with:

**ASME ISHOW**

The aim of the report is to contribute to a longitudinal study on ISHOW’s accelerator impact by informing the future strategy for data collection for the past ISHOW applicants, finalists (ISHOW regional), and winners (who have participated in ISHOW Bootcamp). This was achieved by identifying best practices for assessing process due diligence (for past applicants) and measuring both qualitative and quantitative data pertaining to return on investment (ROI)/social return on investment (SROI) (for finalists and winners).

The results indicate that the Ventures have a tremendous downstream impact on the communities they serve in terms of service delivery, job creation and improvement in living standards. Additionally, interviewees alluded that the ISHOW Bootcamp sharpened their skills in hardware development, business model implementation, marketing which has led to overall growth of the business.

Ventures acknowledge the ISHOW’s recognition and visibility as a major contributor to their grant success and customer trust. Ventures have seen a steady growth in revenues, partnerships and continuous product improvements attributed to ISHOWs Bootcamp. As a result, past winners are willing to join the ISHOW Alumni Network. Ventures expect a lot of networking, benchmarking, knowledge sharing during the ISHOW Alumni network sessions. Alumni network will enhance direct and collective engagement of past winners with ISHOW. It is recommended that the Alumni network is piloted in 2023 to improve ISHOW engagements and networking amongst past ISHOW winners.

**Outcome:** Impact evaluation of ASME ISHOW and recommendations for further participant engagement







# ASME ISHOW Advancing ASME ISHOW Program Workflows

Fellow: **Anish Agarwal**, India  
 Partner collaborators:  
**James Creel**, Senior Program Manager, USA  
**Erin Peiffer**, Research Manager, USA

This work is in collaboration with:  
**ASME ISHOW**



**Key supported provided to ASME ISHOW**

With an emphasis on the design and engineering process of bringing physical items to market, ASME ISHOW is a global accelerator for hardware-led social innovations with a focus on bringing physical goods to market that benefit society and the environment. ISHOW finalists have the opportunity to win seed funds, in-kind support, design services, travel stipends, and marketing and business development assets. They also join the ISHOW alumni network, a global group of hardware innovators and stakeholders with access to special resources and experts.

Specific tasks completed included the development of an improved template for tracking ISHOW India, Kenya, and USA applicants and events to ensure more efficient delivery of the program. Additionally, notes from the judges and facilitators for all three 2022 ISHOWs were compiled and synthesized to provide finalists useful feedback to enhance their products, go-to-market strategies, and business models. Lastly, survey data from ISHOW applicants were analyzed as part of the organization’s ongoing impact evaluation strategy.

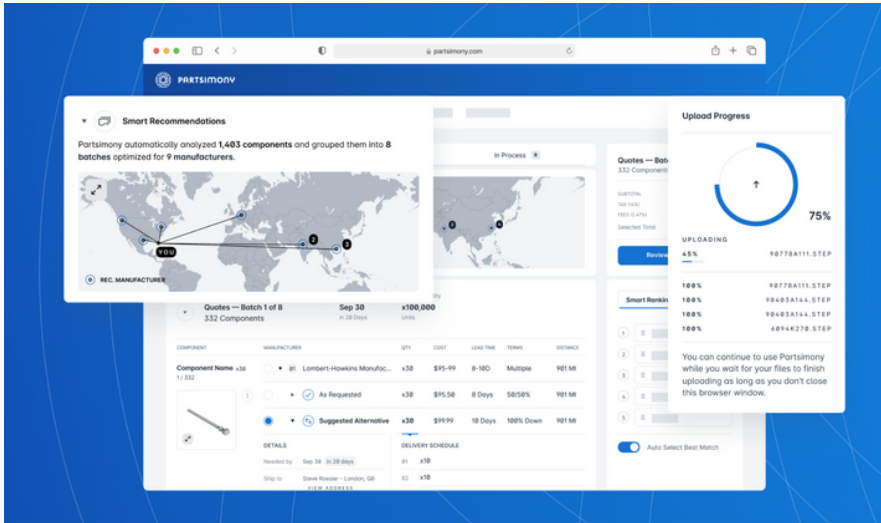
The objectives of this project were to support ISHOW by improving the efficiency of the program, particularly by advancing program workflows through the development of templates for program management and data analysis.

**Outcome:** Improved efficiency of ISHOW program workflows



Partsimony

# Developing a Plug-in to Support Intelligent and Sustainable Manufacturing Supply Chains



**A supply chain network or platform to connect designers, manufacturers and end users together**

This work was supported by: [Autodesk Foundation](#)

Fellow:

**Nwalo Okechukwu**, Nigeria

Expert Fellow:

**Paulo Vela**, Peru

Partner collaborators:

**Hugo Meissner**, Frontend Lead, Poland

**Moses Arigbede**, DevOps Lead, Nigeria

This work is in collaboration with: [Partsimony](#).

Autodesk technology used in this project: **Forge, Fusion 360, and Inventor**

Due to enhanced industrialization, today's product designers and manufacturers face complexity in producing and delivering a product or service to end-users. Some factors which contribute to this include increasing demand variability, product designs being more complicated than ever, manufacturing capacity constraints, intense global competition, and increasing customer expectations. Like other sectors, the manufacturing industry is seeing an increase in reliance on technology to complete the production process. With an estimated 80% of the world's manufacturers being subcontractors, placing a focus on the functionality of the supply chain will help manufacturers avoid having a weak link in their supply chain that could set back production or negatively affect product quality.

Partsimony helps hardware companies turn designs into products with less time, capital, and frustration than ever before. It develops an intelligent supply chain platform that combines data-driven insights with deep industry expertise to help hardware companies conquer the chaos of distributed manufacturer networks. Partsimony, in alliance with Engineering for Change (E4C), is developing a smart supply chain system that eliminates the stress and hassle which occurs in the design and manufacturing of products.

When products are designed by engineers, most times, these designs are complicated for the designer to fabricate. Then comes the struggle to find a competent manufacturer that can manufacture the product at optimal cost and time.

Using a smart network and supply chain system, Partsimony and E4C innovates a bespoke method to drastically reduce downtime in production by integrating a plugin or add-in unit to CAD software such as Autodesk Fusion 360, Autodesk Inventor, Solidworks, BIM 360, and so on to aid and connect designers with reputable companies that can manufacture their design at a low cost and minimum time, and also relate the designs to the precise target market or audience. The artificial intelligence system extracts production and manufacturing information from the software (designer) and sends the data to Partsimony which uses its IoT and smart networking to get the best manufacturer for the product.

**Outcome:** Development of method to reduce downtime and costs in manufacturing production





BamCore

# Improving Engineer-Architect Communication and Workflows for Bamboo-Based Construction

Fellow: **Patricia Lamas**, Spain

Expert Fellow: **Julio Duarte**, Paraguay

Partner collaborators:

**Brenden Morton**, Director, Platform & Job Engineering, USA

**Nich Allan**, Director, QC & Product Development, USA

This work was supported by:

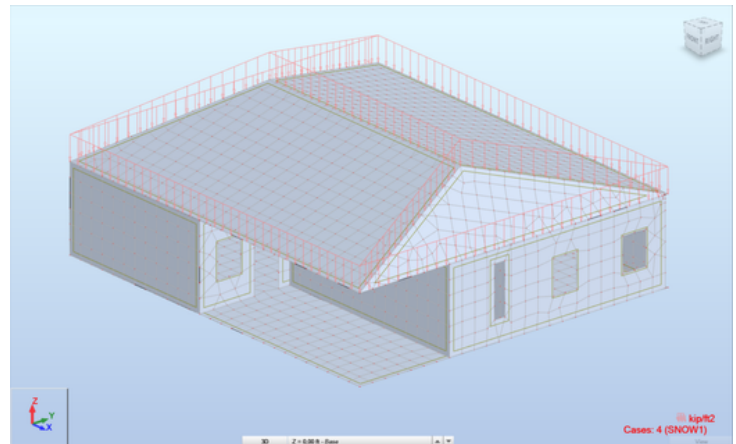
**Autodesk Foundation**

This work is in collaboration with:

**BamCore**

Autodesk technology used in this project:

**Revit, Robot Structural Analysis, and Dynamo**



*Meshed Robot's BamCore model with an implemented service load*

Living up to BamCore's goal of "reduce carbon, cost, labor, and time" this project's purpose was to simplify BamCore's bamboo panel design process by opening a new communication channel between the architect and the engineer. This interaction has been made possible by implementing a new feature of the BIM procedure with Revit and Robot, software from Autodesk.

The goal was to link the architectural designs of BamCore's bamboo-based prime wall solution with the calculations and verification procedure conducted by the engineers. To get started, we surveyed our engineer collaborators to understand their design methods and needs, gathering information on how to make BamCore's design procedure more efficient.

We realized the engineering team was very attached to their calculation methodology, yet they struggled with the translation of an architectural design to a structural design. It was noted that the best way to gain efficiency could be to enhance a workflow to upgrade the architect-engineer communication. We explored replacing conventional communication channels such as Autocad with a new Revit to Robot workflow.

This new procedure allowed us to cut time on technical exchanges, using the model as the main support. The Robot model also allowed us to obtain the calculation results such as shear efforts and deflections on the bamboo panels. Engineers can, from this output, verify the panel's resistance and whether it meets design criteria.

The workflow proposed opens the door to a new design perspective. On this basis, architects and engineers are no longer isolated agents of the design process but a workforce that collaborates within the same model, pushing each other into new ways to achieve a more efficient and sustainable design.

**Outcome:** Improving team collaboration and workflows for more efficient design of bamboo based solutions





Build Change

# Automating Structural Retrofits for Low-Income Households in Bogotá, Colombia

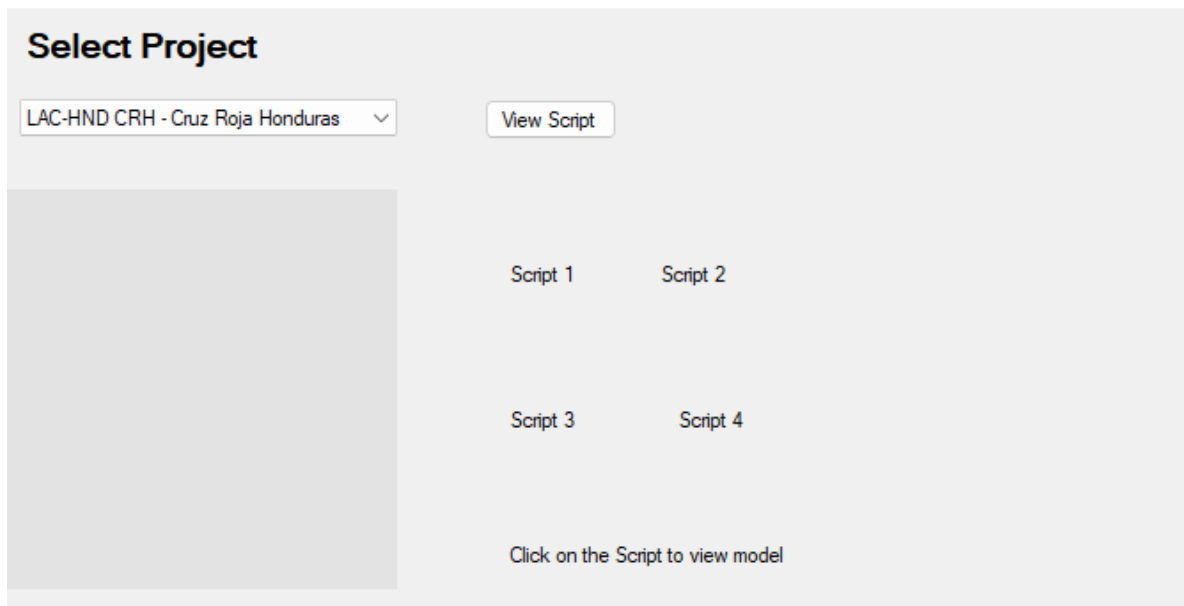
Fellow: **Deji Adebayo**,  
Nigeria

Expert Fellow: **Nicolas  
Kalimba**, Rwanda

Partner collaborators:

**Stefano Pompei**, Technology for Engineering Project Manager,  
Spain

**Charles Jonathan Ciro Tabares**, Tech Coordinator, Colombia



**Main Form to select the files and run**

This work was supported by: [Autodesk Foundation](#)

This work is in collaboration with: [Build Change](#)

Autodesk technology used in this project:

**Revit**

In Colombia, substandard housing is a major issue affecting metropolitan areas because most dwellings are built informally, without following national or international building standards and without technical supervision during construction. Large communities are now subject to earthquakes, floods, and landslides because of the increased rural-to-urban migration. Build Change has been collaborating with Colombia's governmental entities to use Autodesk software to create tools able to streamline and partially automate the design of structural retrofits for these vulnerable dwellings.

Through the deployment of a plugin that will be integrated into Autodesk Revit, the fellowship aimed to help Build Change initiatives by further simplifying the workflows put in place. The plugin will help in both managing files because it will connect directly to predefined Build Change Google Drive folders to access Dynamo scripts, and managing users' access, so users can only access script files assigned to their email addresses and run the Dynamo script assigned to them.

**Outcome:** Streamlining and automating design of structural retrofits for low-income households



## EarthEnable Affordable Housing Alternatives



**Artistic impression of two different 35sqm housing options with a Hipped roof**

Fellow: **Ben Wokorach**, Uganda

Expert Fellow: **Julio Duarte**, Paraguay

Partner collaborators:

**Athanase Nzayisenga**, Sr. Global Research & Development Manager, Rwanda

**Jeanne D'Arc Akayezu Mizero**, Civil Engineer, Rwanda

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**EarthEnable**

Autodesk technology used in this project:

**Revit**

EarthEnable affordable housing alternatives are simple adobe earth structures with five different floor area sizes (25sqm, 35sqm, 45sqm, 50sqm and 55sqm) designed for the low-income population of rural Rwanda. The organization's goal is to increase accessibility to decent, durable and affordable housing in the region.

Access to decent, durable and affordable housing is a challenge in most parts of rural Rwanda. As a result, the majority of the population resorts to run-down adobe block housing structures with dirt floors, which according to EarthEnable, is proven to cause many health and sanitation problems such as childhood asthma, diarrhea, malnutrition, and parasitic infestations. EarthEnable has been at the forefront of reversing these negative health impacts through their proprietary improved earth floors. Now they are scaling their impact by offering access to entire house designs.

The major project goals and activities were;

1. Making adjustments on 13 existing layouts for the house designs to improve on functionality, constructability and aesthetics
2. 3D modeling of the layouts in Revit, exploring different finish materials, color, texture and roofing styles common within the Rwandan context

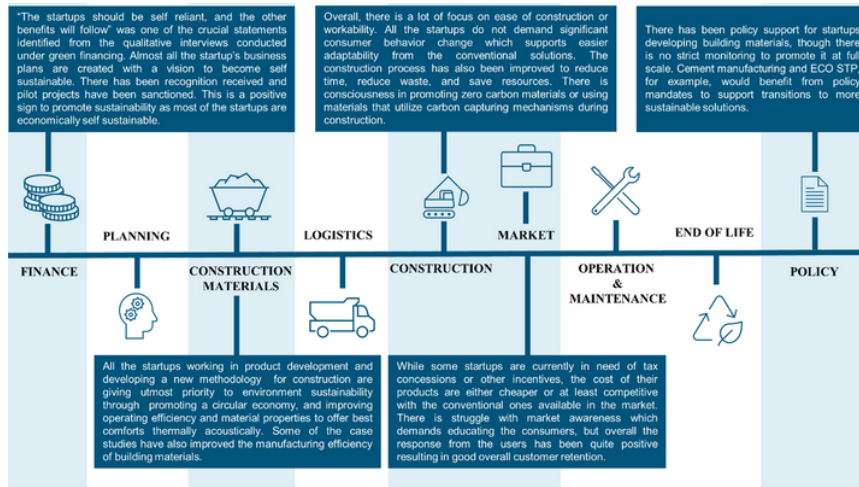
3. Rendering the 3D models in Artlantis studios
4. Compiling the outcomes in a graphic support package, a catalog containing JPEG files of the floor plans and rendered images of the housing models for marketing purposes to users and customers

This work will help EarthEnable in visualizing and analyzing construction implementation scenarios that make efficient use of limited resources, assist in obtaining user feedback on the design, and inform marketing activities. Overall it aims to increase their impact in the Habitat sector, providing affordable, durable and beautiful housing options for the rural population of Rwanda.

**Outcome:** Development of designs and layouts for affordable housing solutions in Rwanda



# Habitat for Humanity Terwilliger Center for Innovation in Shelter (TCIS) A Landscape Analysis of Sustainable, Circular Housing Solutions in India



**A framework to define the status of sustainability within the scope of the study steps of the value chain of construction**

Fellow:

**Sudhamayee Pochiraju, India**

Partner collaborators:

**Anoop Nambiar, Country**

Director

**Shyam Chander Kunagaran,**

Senior Market Systems

Specialist

**Deepak Visvanathan, Senior**

Technical Advisor

**Juan Pablo Vargas, Senior**

Advisor, Innovation,

Entrepreneurship, and Markets

Systems, Applied Innovation

**Jennifer Oomen, Director,**

Applied Innovation, TCIS

[Click here to view the full report](#)

This work is in collaboration with: **Habitat for Humanity TCIS**

This research report details a landscape analysis of sustainable housing solutions in India for Habitat for Humanity. As India is a large and heterogeneous country, this research used a case study approach through desk research and interviews with experts to identify new sustainable construction solutions which were then benchmarked against national institutional guidelines and policies on sustainable construction.

The benchmarking framework was used to identify where solutions addressed various sustainability considerations. From the solutions benchmarked, there appears to be positive growth towards promoting environmentally friendly materials that are also price competitive in the market. All the products reviewed are currently strengthening their supply chains by using local resources, making the manufacturing more efficient than conventional methods, and ensuring operational efficiency, in addition to maintaining price competitiveness. Additionally, there appears to be a positive policy push to support pilot projects and relevant seminars,

but there is still a lack of awareness among users and fraternity for promotion of these new materials. Being a part of the schedule of rates, approval from various standards and testing organizations to enter the mainstream construction value chain still remains a challenge. Further support such as lowering the goods and services tax, increasing incentives and access to funding, as well as showcasing new solutions at large events can help users become familiar with these new materials.

Overall, there is a positive step being taken by various private stakeholders to come up with materials that are sustainable across various parameters, but there is still a long way to go for them to completely replace the conventional materials through the adoption of the masses.

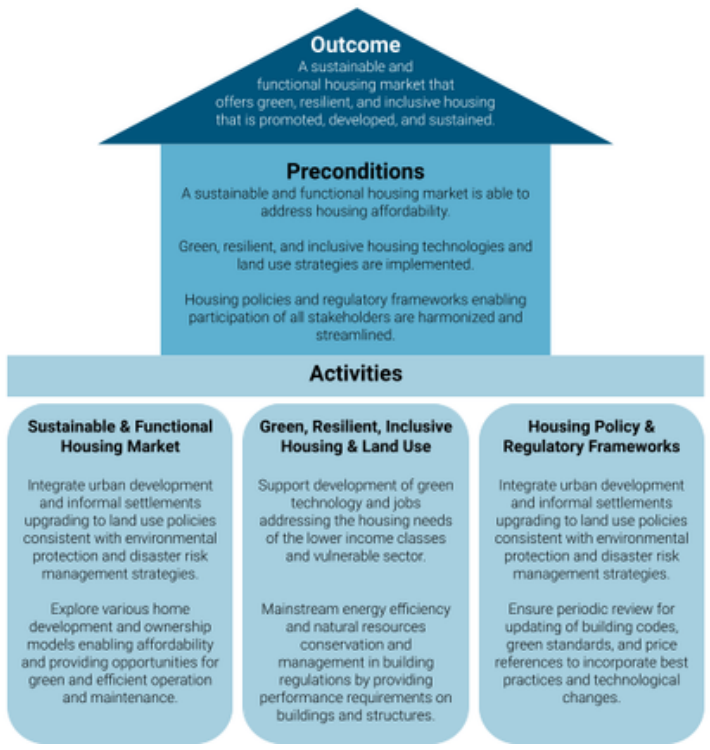
**Outcome:** Analysis of sustainable housing solutions in India



**Terwilliger Center for Innovation in Shelter**



# Habitat for Humanity Terwilliger Center for Innovation in Shelter (TCIS) A Landscape Analysis of Sustainable, Green, and Circular Housing Solutions in the Philippines



**Theory of Change to achieve a sustainable and functional housing market that offers green, resilient, and inclusive housing**

Fellow:

**Dean Ashton Plamenco**, Philippines

Partner collaborators:

**Jessan Catre**, TCIS, Habitat for Humanity International

**Jerick Axalan**, Market Systems and Entrepreneurship Specialist at Habitat for Humanity International

**Juan Pablo Vargas**, Senior Advisor, Innovation, Entrepreneurship, and Markets Systems, Applied Innovation

**Jennifer Oomen**, Director, Applied Innovation, TCIS

This work is in collaboration with:

**Habitat for Humanity TCIS**

[Click here to view the full report](#)

This study aimed to answer the question “how might we make green housing more affordable and accessible for financial service providers, builders, and end-users” in the Philippines for Habitat for Humanity. This was accomplished by 1.) defining and analyzing sustainable, green, and circular housing and construction concepts, 2.) mapping the housing value chain to identify stages, stakeholders, approaches, challenges and opportunities to greening the affordable housing value chain, and 3.) developing a Theory of Change to explain how a green and circular housing value chain can be achieved.

Through mapping the housing value chain, emerging themes, solutions and innovations, enabling interventions, and capabilities and preconditions were identified. One emerging theme is that the business case for green, while largely enabled by financing and policy, does not necessarily require newer construction technologies, they simply must allow for increased supply of housing units. Additionally, there is an opportunity to establish planning and design codes standards that are aligned to green principles. Some of the solutions

and innovations identified across the value chain include passive design strategies and energy and water capture technologies; more efficient construction technologies to reduce resources, waste, and cost; and waste reuse models in material sourcing and production. Additionally, it was found that innovative financing and policy can be used to accelerate housing production by attracting homebuilders to venture into green housing development. Lastly, the Theory of Change developed through this study found that transforming the housing value chain to green unlocks necessary preconditions to ensure a functional housing value chain that can enable homebuilders to participate in the production of housing stock through green financing mechanisms, and at the same time provide green and resilient shelter for end-users.

**Outcome:** Analysis of sustainable and affordable housing solutions in the Philippines



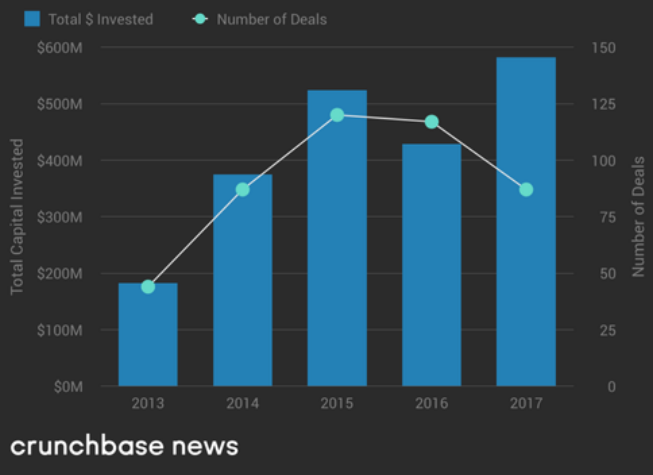
**Terwilliger Center for Innovation in Shelter**

Hometeam Ventures

# Creating a System for Inbound Dealflow of Affordable Housing Construction Technologies

## Venture Capital Funding Of North American Construction Technology Companies

Based on venture rounds raised between 2013 and 2017 by American and Canadian companies in Crunchbase's construction, building material, green building, and smart building categories. Dollar volume based on deals of known size; round counts are for all deals.



### Statistics for Venture Capital investment in Construction Technology

Innovating in the construction industry is necessary to close the housing gap worldwide. Hometeam Ventures invests in and scales double-bottom-line startups that improve the construction life cycle by reducing cost, increasing speed, and improving quality, resulting in more adequate housing globally. An estimated 3+ billion people will be living without access to adequate shelter by 2030. Proper housing is a human right, and its absence negatively affects urban equity and inclusion, health and safety, and livelihood opportunities.

A breakthrough in building efficiency, affordability, and quality will be necessary to meet the world's housing needs. Startups are early-stage businesses with huge ideas, and they frequently demonstrate great innovation, they create a lot of jobs and introduce innovative goods and services that boost our economy. For these reasons, Hometeam Ventures primarily targets young pre-seed and seed entrepreneurs in the building sector. Hometeam ventures aid firms in ensuring that they have good "unit economics" - the revenues and costs connected with the fundamental components of the company's business model - in addition to providing financing to startups.

As more investors enter the market and several venture capital organizations are established with the intention of investing in building technology, it is crucial for the Hometeam ventures to identify these new businesses at an extremely early stage.

Fellow: **K Shakthi Dhar Reddy**, India

Expert Fellow: **Martín Ignacio del Pino**, Argentina

Partner collaborators:

**Julieta Moradei**, Partner and Founding Member, USA

**Alexandria Lafcsi**, Founder and Managing Partner, USA

**Luisa Mendes Brasil**, Project Manage and Head of Research Fellowship, USA

**Andra Stanciu**, Strategic Research Lead, USA

**Courtney Hoffchen**, Operation Administration, USA

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**Hometeam Ventures**

This project aimed to support Hometeam Ventures in streamlining their current processes for scouting potential construction technologies to fund that address affordable housing bottlenecks, inputting information into their database, technology and company vetting / due diligence, and tracking timelines. The goal of this fellowship project was to identify the best entrepreneurs that fit their criteria, which are firms in the construction and housing sectors headquartered in the United States who are actively seeking capital. The previous process involved searching through many platforms to select from over 300 million entrepreneurs worldwide formed each year before adding them to a database for interviews and funding rounds. This project identified ways to automate this process, better identify startups and ensure new innovative concepts are not missed. Through this project, the process of collecting organizations' data is now accelerated and streamlined, allowing for data collection on 10 to 1000+ more startups in the time it would have previously taken for one.

**Outcome:** Streamlining and increasing funding for innovative construction startups





Powward Mobility

# Developing e-Mobility Micro-Mobility Bicycle Solutions to Reduce Poverty



*The JUA electric trike with passenger module*

Fellow:

**Shannon Tin Oi Lee, Canada**

Expert Fellow:

**Kyla Strickler, USA**

Partner collaborators:

**Paul Muhia, CEO, Kenya**

**Warren Ondanje, Advisor, Kenya**

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with:

**Powward Mobility**

Powward Mobility have developed the JUA Trike, a product aimed to inspire and sustain the growth of small enterprises by providing affordable and clean transport solutions to enterprising youth, learners, and workers of rural and urban areas. This project aimed to further develop the design of the zero-emission 3-wheeler, making it adaptable for three transportation modes (passenger, cargo, and mobile-shop mode), suitable for rough terrain, and easily built through a 2-step assembly without the need of special tools.

The project considered the design requirements, design constraints, manufacturability and assembly of the modular trike. Modelling and stress simulations were conducted on CAD software, and the bill of materials was completed and evaluated for supplier and shipping logistics.

The trike was designed for manufacturability and offers a competitive edge in its modular structure. The trike can be disassembled into two parts resulting in the smallest shipping crate for trikes on the market. This opens the opportunity for air shipment distribution, accelerating delivery time while increasing its accessibility on a global scale.

The trike has two drivetrains: the primary resembles the drivetrain of a standard bicycle; while the second is entirely confined within the flatbed structure of the trike (protecting the components from damage) and is powered by rechargeable lithium ion batteries.

The flatbed structure is supported by motorcycle shocks to ensure passengers and transported goods are undisturbed during transport. The passenger mode can transport up to two adults and three children in addition to the driver. The cargo and mobile-shop mode can transport goods of up to 450kg (including the driver).

With these design considerations and manufacturability in place, the JUA trike can be locally assembled without the need of experts and its optimized design in modularity for efficient shipping and delivery can ensure every aspect of the world can have access to clean energy and sustainable transportation.

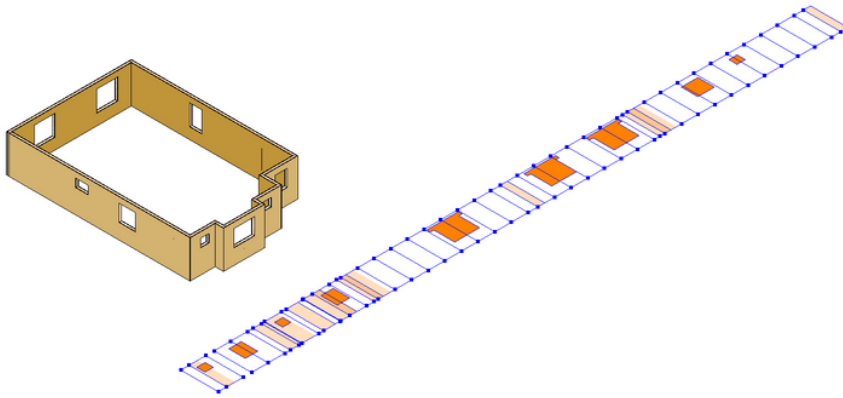
**Outcome:** Development of zero-emission 3-wheeler





BamCore

# Reducing Embodied Carbon in the Built Environment Through Bamboo-Based Material Usage Rules



*Original model and the panel design for the entire building envelope, highlighting the waste pieces from cutting the panels for openings and edges.*

Autodesk technology used in this project:

**Revit and Dynamo**

Fellow:

**Elena Vazquez**, Paraguay - USA

Expert Fellow:

**Nicolas Kalimba Rugamba**, Rwanda

Partner collaborators:

**Brenden Morton**, Director, Job Engineering, USA

This work was supported by:

**Autodesk Foundation**

This work is in collaboration with: **BamCore**

This project developed a digital workflow to reduce waste material in implementing BamCore's bamboo-based Prime Wall system. The company produces an environmentally-sound bamboo paneling system that can be used in commercial and residential low-rise buildings. BamCore operates in a design-driven scenario where it is crucial to know which panelization rules lead to the least waste, thus, reducing the systems' carbon footprint. We, therefore, developed a digital workflow in Dynamo that will help BamCore optimize its building panelization process for reduced material waste.

The first step in developing the workflow was to understand the variables that come into play in defining the panelization of buildings. The variables identified include the location of windows and doors, whether or not the openings need lintels, the bamboo panel standard dimensions, and the location and quantity of walls. Most of these variables are not defined by BamCore but, instead, a consequence of project constraints for design and structural requirements. What can be determined, however, is the paneling start point, i.e. where to place the first panel in each one of the walls to be panelized. Consequently, the digital workflow developed uses the start point of panelization as the primary variable to define reduced waste production.

The digital workflow is intended to be a design tool that can aid the user in deciding how to design the panels for different projects. The waste material in this process is generated due to cutting the standard bamboo panels to fit defined wall dimensions. In the digital tool, the generated waste is automatically evaluated using custom nodes in Dynamo, both in quantity and quality. At the same time, the script also estimates the percentage of reusable waste pieces, representing the pieces that are large enough to be easily reused in other projects. The tool, therefore, allows for real-time feedback on how different panel start points affect the total waste generated in the project.

While the user can use the tool manually to try out different panel start points and variables, users can also automatically define the panelization start points for all the walls. Generative Design, a feature now available in Revit, can be used to automatically find the most optimal panel start point for all the walls in the project. Generative Design helps save time in defining the panel design for each partition in the project while ensuring that the least amount of material goes to waste.

**Outcome:** Reduction of waste material in bamboo-based paneling system

The Industrial Commons - Material Return

# Improving System Management of Inventory Material Return for Circular Economy

Fellow:

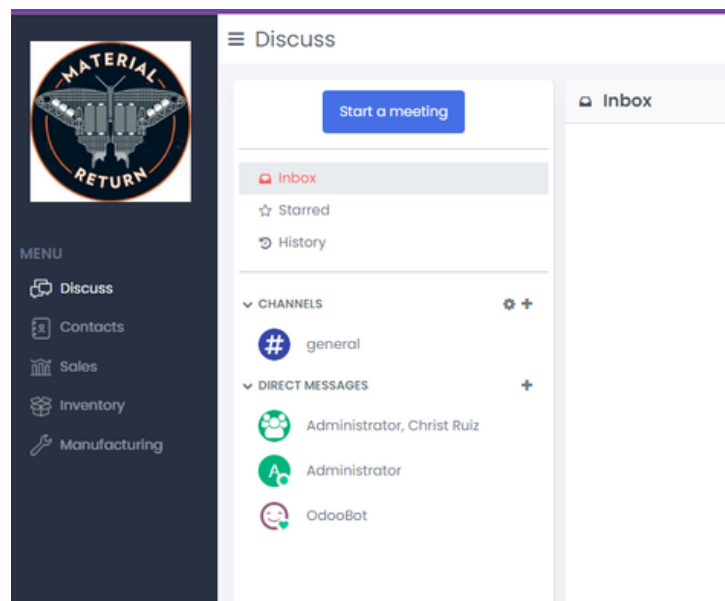
**Christ Stefany Ruiz Ortiz**, Peru

Expert Fellow:

**Martin del Pino**, Argentina

Partner collaborators:

**Bob Carswell**, R&D director from Material Return,  
USA



*Main view of Odoo system implemented as a solution for Material Return*

This work was supported by: [Autodesk Foundation](#)

This work is in collaboration with: [The Industrial Commons – Material Returns](#)

Material Return, part of The Industrial Commons, is an industrial enterprise that creates high quality products from textile waste. The goal of this project was to develop an integrated process for inventory management that would streamline their current workflows and provide visualization of their transactions and processes. Additionally, an improved system would provide more data security, reduced manual effort, and better integration with other systems.

After reviewing the main process workflows and establishing design specifications for the new system, alternative solutions were evaluated against these specifications.

Odoo was selected as it allows Material Return to visualize all of their inventory information, to maintain

traceability, and to document procedures. To implement the system, servers were purchased, a private IP was created, and the system was adapted to reflect the inventory and manufacturing processes as modules within the Odoo system. The system was then tested and reviewed by the partner for approval. Documentation was developed and shared with the partner to ensure proper knowledge transfer to the partner so that they are able to continue to utilize this system going forward.

**Outcomes:** Inventory management system to streamline workflows and visualize inventory information





Vartega

# Global Recycling Standard Certification for Recycled Carbon Fiber and Composite Recycling Database

Fellow:

**Chung Heung**, Australia

Expert Fellow:

**Martín Ignacio del Pino**, Argentina

Partner collaborators:

**Andrew Maxey**, Founder & CEO, USA**Ed Pilpel**, Director, USAThis work was supported by: [Autodesk Foundation](#)This work is in collaboration with: [Vartega](#)

*Logos may be used for Global Recycled Standard certified products*

In recent years, it has been observed that enterprises must demonstrate a commitment to environmental sustainability, protecting natural resources, and diverting material from waste streams. In the recycling industry, Global Recycled Standard (GRS) which was authored by Textile Exchange has become increasingly popular and sometimes becomes a hurdle requirement for companies to enter specific markets. Similar to the International Standards Organization (i.e. ISO standards), GRS has a series of requirements that an applicant needs to satisfy. Thus, this research project partnered with Vartega is pertaining to contributing to Vartega's mission of obtaining a GRS certification for their carbon fiber recycling business by conducting research on the certification process and developing a plan to achieve this.

It has been recognized that Vartega's core business, which is recycling operation on composite materials, is eligible for a GRS certification, and a series of requirements listed in such standard were identified.

A certification body, Scientific Certification Systems (SCS Global Services) has been appointed and an exhaustive checklist of required documents regarding the GRS certification has been obtained.

While Vartega is preparing to demonstrate compliances and SCS will be conducting the site audits, the focus of the project has later shifted to creating a database mapping the existing composite recycling companies assist the American Composites Manufacturers Association (ACMA). A Google form was created and an introductory email was drafted to be used as means for requesting information from the composite recyclers in the industry.

Future works regarding the GRS certificate include completing a full set of policies in accordance with the checklist and preparing for SCS's on-site audits. This certificate might allow Vartega to sell their low-cost recycled carbon fiber to the Chinese EV market to reduce the overall emissions in the vehicle industry.

**Outcome:** Research and planning for GRS certification for carbon fiber recycling business





ASME

# Development of ASME's Climate Action Position Statement



*Fellow supporting project with solar and hydroturbines - the future engineering workforce will be essential for addressing climate change*

Fellows:

**Kingsley Ukoba**, Nigeria/South Africa

Expert Fellow:

**Sahar Shamsi**, Canada

Partner collaborators:

**Iana Aranda**, Engineering for Change President, USA; **Anand Sethupathy**, Managing Director, Programs at ASME; **Aaron Weinerman**, Senior Manager, International Development at ASME; **Neil Yeoh**, Founder & CEO, OnePointFive; **Matthias Muehlbauer**, co-founder, OnePointFive; **Jack Kozyrski**, Sustainability Associate, OnePointFive

This work is in collaboration with: [ASME](#)

Founded in 1880, the American Society of Mechanical Engineers (ASME) has a longstanding history of responding to new challenges, as demonstrated through the development of boiler codes and standards to ensure safety during the industrialization period. Over 140 years later, the threat of climate change demands the attention of professional engineering societies and standards organizations to help ensure a safe future for people and planet. ASME is uniquely positioned to take action against climate change through the development of new relevant codes and standards for technologies towards decarbonization and by attracting, training, and mobilizing engineers to deliver climate solutions towards a sustainable future for all.

The objective of this project was to support in the development of ASME's Climate Action Strategy. In collaboration with the ASME team and consultants at OnePointFive, ~90 documents reviewed and synthesized and interviews were conducted with 22 stakeholders to understand perspectives, current ASME aligned initiatives, and leading organizational practices and insights.

The due-diligence process informed ASME's approach to addressing climate change with the following drivers:

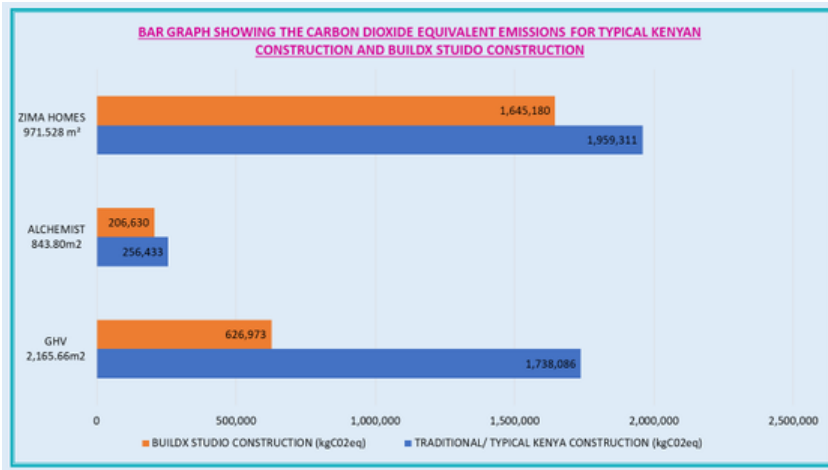
- Support the global consensus of climate science and the Intergovernmental Panel on Climate Change (IPCC)'s target, currently limiting global warming to 1.5 degrees Celsius above pre-industrial levels.
- Enable engineers in accelerating the drive towards net-zero emissions and a carbon negative future.
- Facilitate communication on climate policy among government, industry, and academia—leveraging ASME's successful history of providing nonpartisan expertise to policymakers.
- Develop and engage the international engineering workforce that meets our present and future climate challenges.
- Align ASME's sustainability and climate strategy to the United Nations' Sustainable Development Goals.

**Outcome:** Advancement of ASME Climate Action Strategy



# BuildX Towards Net Zero Buildings in Kenya

**Combined bar graph showing the embodied carbon of BXS Case Projects for BXS materials and typical Kenyan construction materials**



This work was supported by: [Autodesk Foundation](#)  
 This work is in collaboration with: [BuildX](#)

Fellows:

**Sheila Atieno Ojwang**, Kenya

Expert Fellow:

**Kalimba Rugamba Nicolas**, Rwanda

Partner collaborators:

**Carolyn Schramm**, BuildX Head of Impact, Kenya

**Esther Segero**, BuildX Head of Construction, Kenya

**Alice Wachera**, Graduate Structural and Civil Engineer, Kenya

Autodesk technology used in this project:  
**Revit**

BuildX Studio is dedicated in working towards net zero carbon buildings in Kenya by measuring and lowering the carbon footprint of building projects. The objective of the fellowship was to improve BuildX Studio’s internal approaches for carbon analysis and the data generated provides the firm with insights on the design of their internal carbon calculator in terms of further development and implementation. Furthermore, the fellowship set out to establish carbon benchmarks for traditional building approaches by contributing to the body of knowledge on sustainable design in Kenya by providing local Life Cycle Analysis (LCA) data.

The fellowship mainly focused on carbon analysis of different types of design projects in BuildX Studio’s portfolio: Zima Homes (a high-rise affordable housing project), the Alchemist (a commercial project) and Green Heart Village (GHV - a residential project featuring individual homes). The scope of the carbon analysis compared the Global Warming Potential (GWP) of the product stage (also known as ‘cradle to gate’ boundary) by calculating the embodied carbon for modules A1–A3 of the LCA.

A subsequent comparative analysis of the results of the Global Warming Potential of modules A1-A3 from the BuildX Studio’s carbon calculator and Tally was carried out. The deviation of the results which averages 22%, is attributed to the different databases used by each calculator, the data input methods accuracy and the error margins allowed by each platform.

The research concludes that BuildX Studio is a more sustainable practice than typical Kenyan construction. The choice of construction material has a significant impact on project carbon footprints. The project will position BuildX to optimise project carbon analysis and has generated internal capacity for the use of Tally, an Autodesk software for carbon life cycle analysis.

**Outcome:** Development of carbon analysis approaches and benchmarks for sustainable design in Kenya

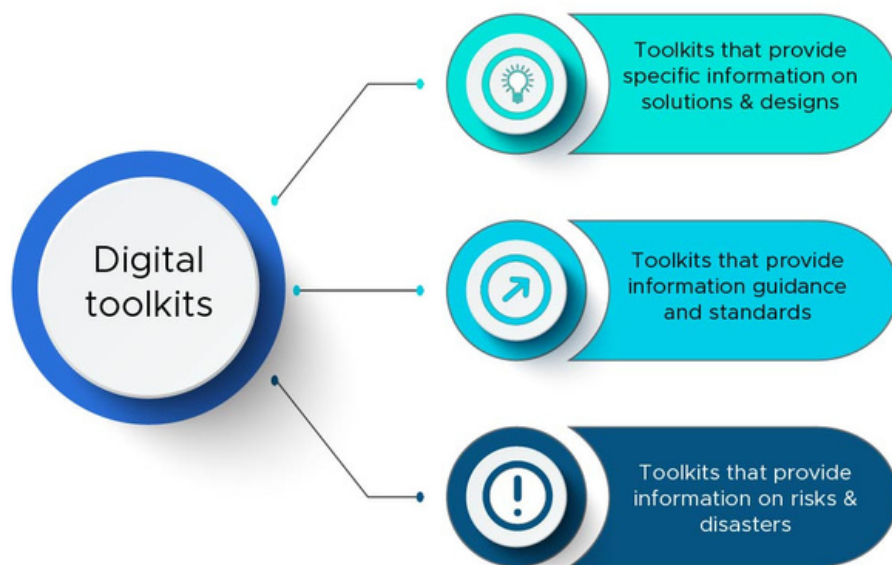




Penn State

# Digital Toolkits for Enhancing Flood and Extreme Heat Resilience of Low-income Housing

*Types of digital toolkits used for disaster risk awareness and resilience approaches in the housing sector*



Fellows:

**Valerie Eve Atieno**, Kenya

**Lorine Ouma**, Kenya

Expert Fellow:

**Julio Diarte**, Paraguay

Partner collaborators:

**Esther Obonyo**, Director Global Building Network, Penn State, USA

This work is in collaboration with:

**Penn State Global Building Network**

This project assessed the application of digital toolkits to enhance awareness and uptake of recommendations on design, materials, and strategies for flood and extreme heat-resilient housing among community members in Florida and Pennsylvania in the United States. The specific areas of focus include low-income housing, sustainable materials, vulnerable housing retrofit measures, climate change responsive design strategies, and toolkits for resilient design solutions.

The objectives were:

1. Assess the current housing needs for communities exposed to flooding and extreme heat in Florida and Pennsylvania
2. Identify the most commonly used materials, technologies, and engineering design strategies for flooding and extreme heat resilience
3. Review existing toolkits for disseminating information on housing risks and potential improvement for communities in vulnerable areas of Florida and Pennsylvania
4. Determine the gaps in knowledge dissemination for existing engineering solutions for climate change resilience of low-income housing
5. Develop a conceptual framework for a digital co-learning platform that can be used by community members to access information on solutions for resilient housing in Florida and Pennsylvania

An in-depth review of related literature through desk research coupled with stakeholder brainstorming sessions and subject matter interviews provided a roadmap that shaped the outcomes of this study. The resilience of low-income housing relies on a holistic approach to the development of design solutions, materials, and strategies that promote flood and extreme heat mitigation. Dissemination of these solutions through digital toolkits that are easily accessible to communities in vulnerable areas enhances the uptake of solutions and creates awareness of flood and heat risks.

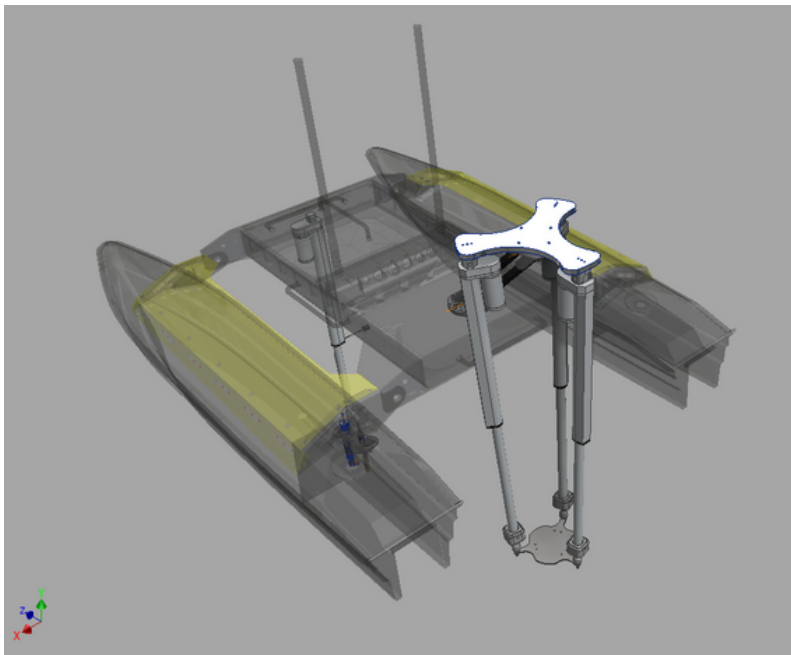
Existing toolkits are limited in their accessibility and efficiency due to the siloed and top-down development, and limited contextual focus. Integration of these toolkits can enhance their use by the stakeholders within the flood and extreme heat risk reduction within Florida and Pennsylvania. This research provides a proposal for an information and knowledge collating platform that can integrate, filter, and simplify flood and extreme heat risks or solutions for the different stakeholders.

**Outcome:** Development of digital platform providing information on solutions for resilient housing in low-income areas



**PennState**

# Design of an Adjustable Sensor for Water Monitoring



**Rendering of the camera stabilizer and water monitoring system assembled to the USV**

Fellow: **Farid Hazameh**, Panama

Expert Fellow: **Kyla Strickler**, USA

Partner collaborators:  
**Humberto Rodriguez**, Director from the FabLab UTP, Panama

This work was supported by:  
[Autodesk Foundation](#)

This work is in collaboration with: [FabLab UTP](#) and [WeRobotics](#)

Autodesk technology used in this project:  
**Inventor**

The adjustable sensor for water monitoring seeks to automate the data acquisition process for monitoring the conditions on the Caribbean coast of Panama for sea cucumber growth. The scope of work of the project resulted in the evaluation of a different design mechanism for the camera stabilizer that could work appropriately under water and sea conditions, mounted in an Unmanned Surface Vehicle (USV).

Firstly, a data acquisition module was developed which consists of a camera stabilizer that enhances the image that will be used in future stages of the implementation for both image and deep learning processing. Secondly, a 1 DOF module was designed which is equipped with 5 water conditions sensors: conductivity sensor, PH sensor, turbidity sensor, dissolved oxygen sensor, and a temperature sensor. The mechanism of the module allows it to acquire data at different levels under water.

The main goal for this stage of the project is to design the mechanism and its parts to be manufactured and assembled, so in subsequent project stages the program could be designed and integrated to the whole system.

This project contributes to PanaSeas' ultimate mission of regenerating local populations of sea cucumbers after their population has been depleted by overfishing to support the environmental benefits they bring to an ecosystem.

**Outcome:** Design of sensor to monitor water conditions for sea cucumber growth





Engineering for Change

# Opportunities for Data-Enabled Interventions in Africa

Fellow:

**Joseph Mdumuka**, Malawi

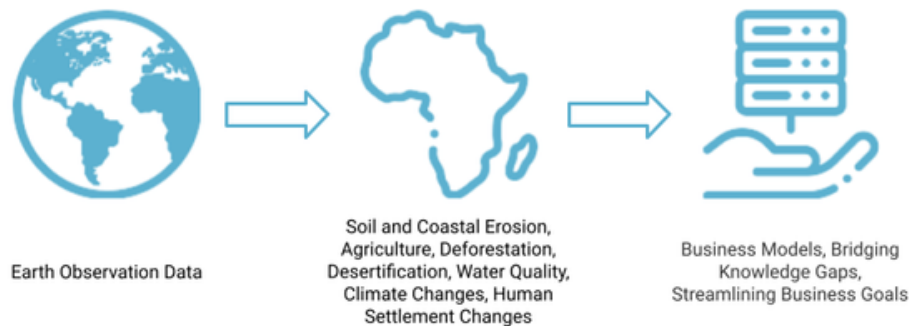
Expert Fellow:

**Himanshu Panday**, India

Partner collaborators:

**Iana Aranda**, Engineering for Change President, USA

**Anand Sethupathy**, ASME Managing Director of Programs and Strategy, USA



***Earth Observation data has tremendous potential for enabling interventions in Africa***

This work is in collaboration with: [Engineering for Change](#)

In this era of Big Data, there are a number of opportunities in different development sectors for innovators to design products and services of high impact that meet end-user requirements and demands, thereby forecasting their profitability, and production.

However, to utilize data in Africa for interventions in different development sectors, a robust data ecosystem needs to be developed to enable knowledge and insights to be shared across different decision makers. This may require a strong computing edge to pre-process the data to be made readily available for usage. This process however is costly due to data gathering and conversion techniques used which contain errors requiring huge amounts of cleaning efforts.

In this research aiming to identify opportunities for data-enabled interventions in Africa, we discovered that African countries can leverage significantly on Earth Observation (EO) data to draw in-depth knowledge and translate into actionable insights to produce valuable and informed decisions on sustainable development across domains.

This EO data can be used in the decision making process of soil and coastal erosion, agriculture, deforestation, desertification, water quality, climate changes, and changes to human settlements.

Harnessing the power of data can enable organizations to develop business models. Through data mining, explorations, modeling, and predictive analysis; product developers can develop new products or further make improvements on their existing products to project their market performance. Data journalists can also write stories of importance that can bridge the knowledge gap on developments leveraging on the same data.

Data can further enable organizations to streamline efficiently their business goals and strategies efficiently, thereby propelling their productivity and profitability by comparing their baseline data with the interventions data to determine if their operations are in fact driving the company to meet their set targets.

**Outcome:** Identified opportunities for data-enabled interventions in Africa

University of Dayton

# A Landscape Analysis of the Field of Engineering and Human Rights

Fellow: **Lauren Reinersman, USA**

Expert Fellow:

**Himanshu Panday, India**

Partner collaborators:

**Kelly Bohrer, Executive Director, Ethos Center, USA**

**Shelley Inglis, Executive Director, Human Rights Center, USA**



*Engineers trained in human rights help balance and redistribute power to vulnerable populations. Source: Vecteezy.com*

This work is in collaboration with:

**University of Dayton School of Engineering and Human Rights Center**

The University of Dayton collaborated with Engineering for Change (E4C) on a landscape analysis of the intersection between human rights and engineering (HRIE) with the goal of understanding current trends and gaps in research, knowledge, and partnerships; existing challenges/barriers to vocational pathways, and potential opportunities for the university and undergraduate curriculum. Twelve interviews across industry, academia, community activism, and non-profit organizations involving engineering and/or human rights and 50+ articles contributed insights in three main areas: curriculum, career pursuits, and research.

**Curriculum:** Education in human rights is itself a fundamental human right and responsibility: the Universal Declaration of Human Rights exhorts “every individual and every organ of society” to “strive by teaching and education to promote respect for these rights and freedoms.” Ergo, articles and interviews emphasize that academic institutions must strive to incorporate education in, at a minimum, the basics of international human rights law, norms, principles, and actors and how to apply these in engineering scenarios locally, nationally and globally. Other university programs have found mixed-discipline collaborative courses and community engaged learning to be successful in demonstrating applicable practices of HRIE.

**Career:** Being well-versed and broad-minded in matters outside of engineering is a highly-valued trait

in employees regardless of whether the job specifically applies to human rights. Students can also apply these skill sets and mindsets specifically to human rights in engineering jobs by leading projects in an ethical manner that is mindful of international labor laws, regional rights treaties, sustainable development goals, and solutions that respect, protect, and fulfill the dignity and rights of all people, particularly those who are most marginalized or vulnerable.

**Research:** Research in HRIE specifically is nascent and often comes out of academic institutions invested in developing their related programs and pedagogical strategies. It is also conducted by organizations investigating how to promote ethical business, diversify engineering skills and experiences, and utilize new technology in rights-conscious ways.

After conducting the landscape analysis, recommendations for universities’ human rights in engineering programs include showing students examples of applying human rights frameworks to the engineering design process, allowing the students to practice that application themselves, and introducing successful and inspirational role models in the field.

**Outcome:** Recommendations for university human rights in engineering programs





Autodesk Foundation

# An Innovative Approach to the Autodesk Foundation's Partnership Success Plans

Fellow:

**Joseph Kurebwa**, Zimbabwe

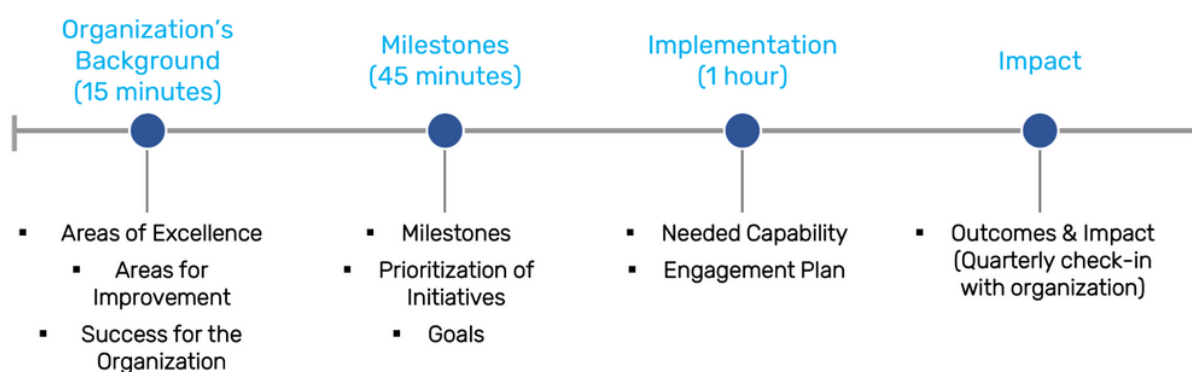
Partner collaborators:

**Bobbie Casey**, Autodesk Foundation Partner Success Manager, USA

Expert Fellow:

**Harsh Vyas**, India

This work is in collaboration with:

**Autodesk Foundation**

*The proposed long-term partner success plan workflow*

The Autodesk Foundation invests in a diverse range of organizations through funding, technology, and talent. It uses Partnership Success Plans (PSPs) to document proposed and completed engagements with its portfolio organizations. This project's focus was to develop more interactive PSP creation methods that keep track of the goals, required resources, desired outcomes and impact in both short-term (<1 year) and long-term engagements. In consultation with an Autodesk customer outcome executive, a new model was adapted from the Autodesk commercial division's customer success plan framework and tested with one of the Foundation's long-term investees.

It is designed to be pre-populated then finalized in a two-hour workshop by representatives from the Foundation and portfolio organization. The organization's background details areas of excellence, areas for improvement and the organization's mission. This information is used to guide the formulation of three to five milestones for the partnership. The milestones are then broken-down into specific initiatives and ranked by a difficulty/importance matrix. Based on their level of

priority, the initiatives are then grouped on a quarterly basis as SMART goals. The needed capabilities and engagement plans for each quarter are then derived from the goals. Finally, the outcomes and impact of the engagement for each quarter are determined by quarterly check-ins with the organization. Color codes are used to tie milestones to the rest of the activities in the process.

The Autodesk Foundation developed templates to incorporate Autodesk value-add services and expected outcomes to facilitate quick and consistent completion. The information is recorded in MURAL and then transferred to a PSP slide deck for presentation and documentation.

Based on the outcomes of the pilot project, this new PSP approach is set to become standard procedure for creating and documenting engagements across the Foundation's portfolio, ensuring that organizations get the needed support in a timely manner.

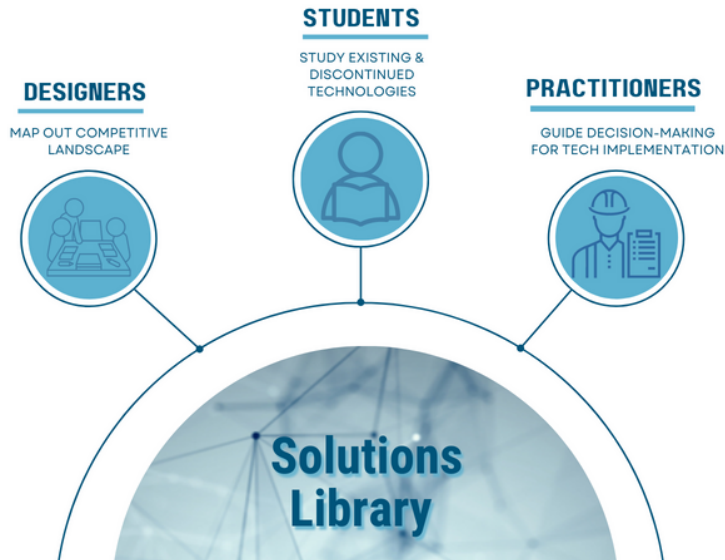
**Outcome:** Development of new workflow for Autodesk Foundation Partnership Success Plans



Engineering for Change

# Maintaining a Living Database: Ensuring Value, Sustainability, and Optimization of the E4C Solutions Library

## Solutions Library User Categories



This work was sponsored by: [Siegel Family Endowment](#)

This work is in collaboration with: [Engineering for Change](#)

Fellow:

**Racheal Nalwoga**, Uganda  
**Sandra Ineza Sinzi**, Rwanda

Expert Fellow:

**Sahar Shamsi**, Canada

Partner collaborators:

**Carolina Rojas**, Engineering for Change, Program Associate, Panama

The Engineering for Change (E4C) Solutions Library (SL) is a living global database of technology-based solutions (i.e., products) that are designed to be accessible and suitable for underserved communities or individuals living in resource-constrained environments. This 'knowledge platform' was established in 2012 in response to the need for readily available and dependable information on existing technologies. Since then, hundreds of fellows, academic and industry experts, and others have contributed to the SL. The SL has grown exponentially (and continues to grow) with 1000+ solutions covering various sectors including ICT, Energy, Water, Sanitation, Transport, Health, Habitat, and Agriculture sectors, with a focus on solutions appropriate for implementation and use by underserved communities. All information in the SL is written for general audiences, while data included on each technology is presented from a technical lens, based on the guidance of expert advisors regarding technical performance, market and compliance, evaluation methods, and standards. The information taxonomy is standardized across all products, enabling side-by-side comparison and analysis.

In this way, the SL serves as a resource for mapping out existing technologies that are available globally and therefore helps to identify gaps where solutions are needed or where existing technologies fall short. Even though the SL grew exponentially from 2016 to 2020 (and continues to grow), there have been some challenges in maintaining this platform and creating value to its intended users. Its maintenance requires a significant amount of time and resources, there is a rapid advancement in technology, and streamlining new entries to the library.

The objectives for this project were assisting in understanding the value the SL brings to diverse stakeholders, improving the current SL process from product sourcing, selection, inclusion, peer review, and publication to reduce the time and resources required to maintain the database; and identify pathways to ensure long term sustainability of the SL.

**Outcome:** Improved workflows and value propositions to ensure the platform's continuity as a living database



ConservationX Labs

# Supporting the Artisanal Mining Grand Challenge: the Amazon CoLab



*Amazon CoLab Cohort 2 Innovator Teams at the Innovation XChange in Lima, Peru (December 2022)*

This work is in collaboration with: [ConservationX Labs](#)

The Amazon CoLab is a six-month acceleration program to support innovator teams identified through the Challenge with developing, testing, and advancing solutions to protect people and ecosystems in the Amazon, adapting and implementing their technologies in the Amazon of Colombia, Peru, Guyana, Suriname and Ecuador. During our engagement, we supported two cohorts to a total of 18 innovator teams with technologies ranging from hardware to software in all different stages of development.

During the fellowship, we were in charge of systematizing information, updating the databases (search for impact investors and mentors) and monitoring the use of customized tools created to improve the team's ventures. The Amazon CoLab assists teams with product development, market validation, business development, and field-testing to enable innovations' uptake and adoption. We focused on supporting these technologies through a financial sustainability and environmental and social impact lens in the Amazon region. Additionally, we monitored impact and assessed capacity building and satisfaction of the ventures accelerated to inform continuous improvement of our processes.

Artisanal Gold Mining is such a complex and challenging environment to innovate -limited education of the community, hard-to-access regions, labour-intensive process, and limited flexibility on how the mining cooperatives are set up makes technology adoption particularly tough. Our work intended to provide the innovators with the right toolset for them to be able to navigate these complex environments.

**Outcome:** Innovator support for artisanal gold mining technologies in the Amazon

Fellow:

**Rosakebia Liliana Estela**  
Mendoza, Peru

Expert Fellow:

**Francisco X. Plaza**, Ecuador

Partner collaborators:

**Carmen Zarate**, CXL Program  
Coordinator, Peru

**Cassie Hoffman**, CXL Global  
Development & Innovation Lead,  
USA

CONSERVATION X LABS



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