engineering FOR CHANGE

2023

IMPACT PROJECTS REPORT

By Engineers, for Everyone

We are a Bridge between Engineering & Sustainable Development

We Prepare, Educate, and Activate the International Technical Workforce for the Benefit of People and the Planet

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 2023 Program Management Team, Impact Projects:
Jonathan Kemp, Program Specialist
Erin Peiffer, Program Coordinator
Elizabeth Collins, Program Associate
Tanvir Khorajiya, Junior Program Associate

Published December 2023

AUTODESK FOUNDATION

In 2023, E4C welcomed our largest Fellowship cohort ever: 65 Fellows from all over the globe. This year, the Autodesk Foundation collaborated with E4C to support 29 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 2024, 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:
www.engineeringforchange.org/research

Read more about our Fellowship and Research Fellows:
www.engineeringforchange.org/fellowship

Find out about becoming a research partner:
www.engineeringforchange.org/impact-projects

Countries Represented in the 2023 Cohort

Overall Statistics Dashboard

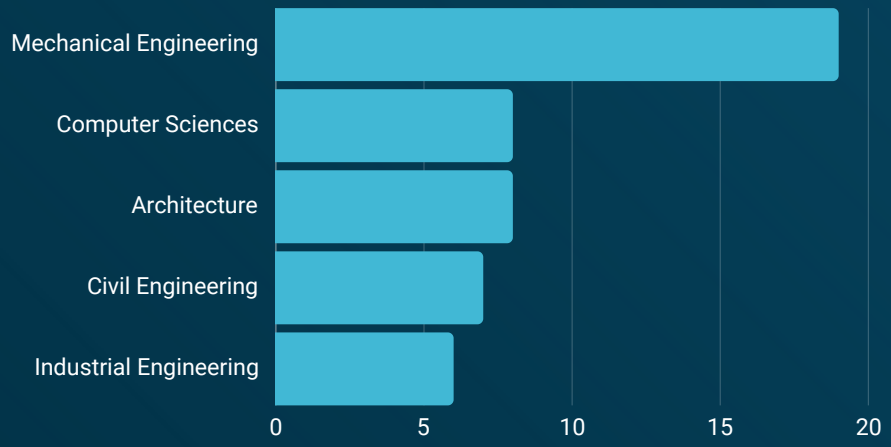
65
Fellows

33
Organizations

44
Impact Projects

25
Countries

Fellows' Most Common Areas of Study



Most Fellows have more than one area of study

74%

are between 25 - 34 years old

40%

Female Fellows

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Kheyti

Design Optimization & Data Analysis for Modular Greenhouses

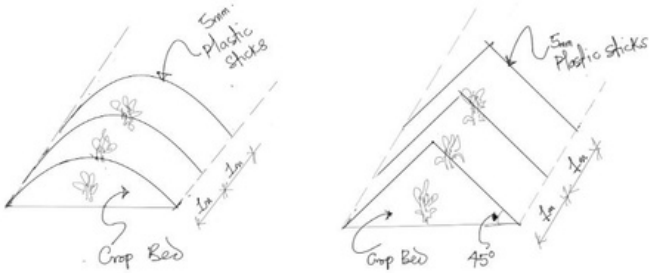
Eight in ten of the world's farmers are smallholders who struggle with climate-affected harvests. Kheyti's Greenhouse-in-a-Box is helping them reduce climate risk and increase their yields. These greenhouses are equipped with a rain tunnel protection system to shield crops from unseasonal and heavy rainfall. However, the existing rain tunnel material (polyethylene plastic) hampers ventilation and leads to significant temperature and humidity fluctuations that can adversely affect crop yields. Additionally, there's a need for a trellising system to support high-density cucumber plantings.

The primary objective of this project was to inform the design and optimization of these critical components (rain tunnels and in-built trellising systems) within modular greenhouses.

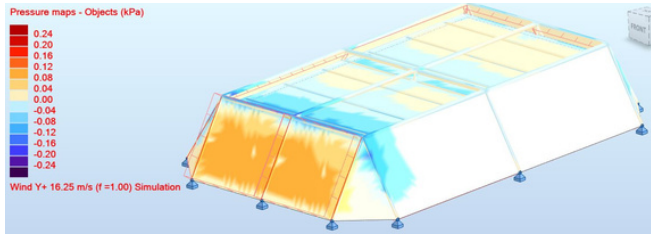
To achieve this, extensive desk research was conducted on various rain tunnel fabrics to enhance ventilation and temperature control within the tunnel. This led to the development of different material and design options, ready for on-farm testing. Additionally, Autodesk Revit and Robot Structural Analysis were used to perform structural analysis, design, and optimization of the in-built trellising system. The results and outputs encompass design drawings for the rain tunnel, offering improved ventilation, and a structural analysis report for the trellising system.

By optimizing these greenhouse components, the effectiveness and efficiency of Kheyti's Greenhouse-in-a-Box were enhanced, thereby benefiting smallholder farmers by improving crop yield, protecting against adverse weather, and promoting sustainable agriculture practices.

Outcome: Design and analysis of greenhouse components to benefit smallholder farmers.



Designs for greenhouse rain tunnel
Attribution: Kheyti



Pressure map - trellis structural analysis
Attribution: Ogechi Ogbonna

Fellow:
Ogechi Ogbonna, Nigeria

Expert Fellow: Maël Sonna, Cameroon

Partner collaborators:

- Ashdeep Seth, Engineering Design Consultant, USA
- Ayush Sharma, Co-founder & Head of Operations, India
- Swaroop Bojugu, Manager - Supply Chain Operations, India
- Ritanshu Raina, Product Designer - Fellow, India

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Kheyti

Technology/ Techniques used:
Autodesk Fusion 360, Revit, Robot SA

KHEYTI AUTODESK FOUNDATION

3 GOOD HEALTH AND WELL-BEING

Life and Limb India Pvt. Ltd.

Design & Development of a Parametric Model for Upper Limb Prostheses

In low- to middle-income countries such as India, many people with disabilities lack access to the rehabilitation and assistive devices they need. According to the World Health Organization, only one in ten people have access to the necessary assistive products. In India, official statistics indicate that there are more than half a million amputees. Reported issues associated with physical disabilities include difficulty performing daily activities, earning income, and discrimination.

The challenges faced by upper limb amputees in India, specific to prosthetic rehabilitation, include limited access to support and the high cost of the product. Prosthetics companies also experience challenges in the design and use of their technology, such as inadequate use of prostheses by patients, lack of availability of appropriate materials, and limited empirical data. Life and Limb aims to increase user uptake and satisfaction of prosthetics by developing new products with sophisticated features to meet individual patients' specific needs and preferences.

Life and Limb Bionicli® prosthetic
Attribution: Life and Limb

This project aimed to support Life and Limb in streamlining the process for creating customized upper limb prosthetics by specializing in parametric modelling, ensuring the 3D models of the prostheses are refined and optimized to meet the unique needs of individual patients.

Primarily, the fellow worked in collaboration with the Life and Limb team to establish a systematic workflow for capturing hand data through 3D scanning. 3D models of upper limb prosthetics were created and refined using parametric modelling techniques. The 3D models were also fine-tuned and optimized to ensure a precise fit and functional design for each patient. Additionally, the parametric modelling procedures were recorded and overall process documentation was developed for future reference and training.

As a result, the optimized parametric models in Autodesk Fusion 360 workspace have been provided to the Life and Limb team, along with the efficient design workflow guidelines and streamlined processes that seamlessly integrate 3D scanning and parametric models.

Outcome: Parametric models and streamlined processes for development of affordable prosthetic limbs.

Fellow:
Esther Ivanova Matamoros
Alcivar, Ecuador

Expert Fellow:
Tanvir Khorajiya, India

Partner collaborators:
- Nishant Agarwal, Founder & CEO, India
- Abhijeet Rai, Computer-Aided Design Engineer, India

This work was supported by:
Engineering for Change
This work is in collaboration with:
Life and Limb

Technology/ Techniques used:
Autodesk Fusion 360, Meshmixer, ReCap Photo

Life and Limb® Private Limited

engineering FOR CHANGE

Stacks+Joules

Hardware Exploration & Development for Educational Lighting Kit

According to data from the Department of Labor Statistics, more than five million young Americans who hold high school diplomas lack the readiness required for college or careers. This represents approximately 32% of high school diploma holders. It is believed that these individuals possess untapped potential that can make a substantial contribution to addressing complex societal challenges. Stacks+Joules is focused on harnessing this potential through its program, which aims to kickstart post-secondary achievement before high school graduation.

The program is based on the idea that students can acquire computer network and programming skills through their creative passions, in this case, specifically targeting opportunities in coding and the Internet of Things (IoT). This project aimed to improve the program and address existing challenges by redesigning Stacks+Joules' classroom hardware for better learning and instructor setup, ensuring better quality at lower costs.

Extensive research was conducted to identify the best industry-standard solutions for implementing new courses, and five top solutions were chosen. From this list, the top 2 hardware kits (TP-Link Tapo and Philips Wiz bulbs) were experimented with.

After facing unforeseen challenges with firmware updates and security issues, further research and iterations were carried out, and a final solution was identified in Philips Wiz bulbs. Accordingly, detailed documentation was prepared, including well-structured codes, demo videos, presentations, and instructions for the updated curriculum. The final hardware was also found to be 64% cheaper than the previous solution, which makes it more scalable.

Outcome: Redesign of hardware to improve a learning program addressing technical skills gaps in coding.

TP-Link Tapo bulbs
Attribution: K Shakthi Dhar Reddy

Fellow:
K Shakthi Dhar Reddy, India

Fellow:
Tunga Tessema, Rwanda

Expert Fellow:
Arya Sarkar, India

Partner collaborators:

- Jonathan Spooner, Founder, United States

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Stacks+Joules

Technology/ Techniques used:
Hardware: TpLink Tapo, and Philips Wiz
Software: Python, REST APIs

STACKS+JOULES

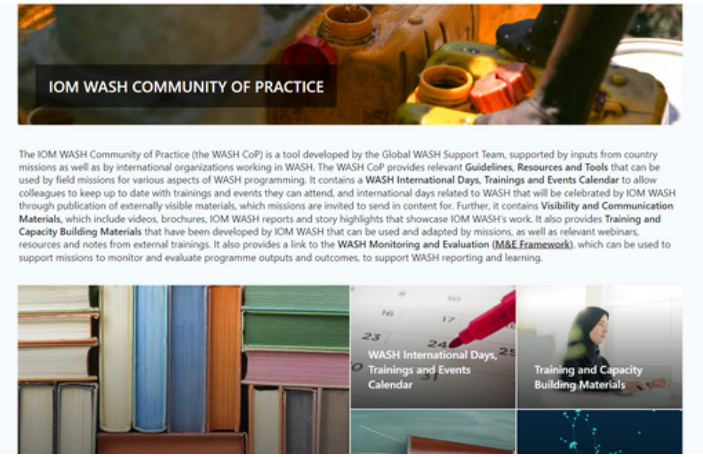
AUTODESK FOUNDATION

6 CLEAN WATER AND SANITATION

International Organization for Migration

WASH Capacity Building and Knowledge Transfer

The International Organization for Migration (IOM) is a global organization dedicated to promoting safe, orderly, and regular migration. Within IOM, the Water, Sanitation, and Hygiene (WASH) Global Support Unit plays a crucial role in ensuring that migrants and displaced populations have access to clean water, proper sanitation, and hygiene facilities. The WASH Global Support Unit provides technical guidance and support to IOM offices around the world to implement effective WASH programs. This project is aligned with IOM's WASH Strategic Plan, which aims to enhance WASH systems and processes for more efficient and high-quality program delivery.



IOM WASH Community of Practice - homepage
Attribution: IOM

The main objective of this project was to improve the IOM WASH knowledge management platform, specifically the Community of Practice (CoP). It aimed to enhance the content and functionality of the CoP to better support ongoing WASH programs and ensure its continued suitability for its intended purpose.

The first step was to conduct a comprehensive review of the current CoP and ensure the content was aligned with the latest documents and insights. This was followed by the preparation of an Excel-based navigation map designed to guide users seamlessly through the CoP. This map will serve as an intuitive tool for users to easily locate and access relevant resources and information within the CoP.

Surveys were then conducted to gather feedback from users regarding the newly enhanced layout, and results were integrated into the CoP. This project also aimed to enhance IOM's Emergency WASH items and catalog featuring commonly used WASH supplies.

Outcome: Enhanced CoP to better support WASH programs.

Fellow:
Hélen Cristina Oliveira dos Reis, Brazil

Expert Fellow:
Hamisa Rizgallah, Kenya

Partner collaborators:
- Farah AlBasha, WASH Officer (Knowledge Management Lead), Switzerland

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
International Organization for Migration
Technology/ Techniques used:
SharePoint

IOM UN MIGRATION

AUTODESK FOUNDATION

6 CLEAN WATER AND SANITATION

Splash

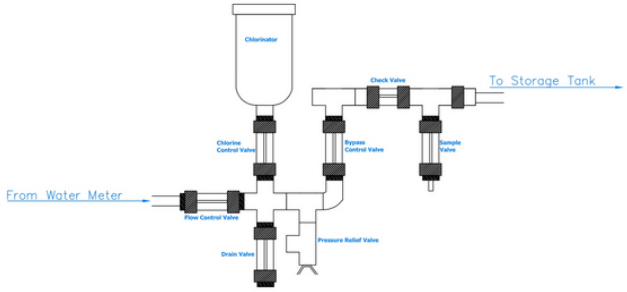
Modification of Purification System Design

Splash is undertaking projects across various locations including Addis Ababa, Kolkata, Kathmandu and China, with the aim of providing clean water for children. One of the organization's notable initiatives is the implementation of project WISE (WASH in Schools for Everyone) within Ethiopian schools. This project is centered around the enhancement of Water and Sanitation conditions within schools situated in Addis Ababa. Through project WISE, an effort is being made to improve the water supply and sanitation facilities within the educational institutions so as to bring about tangible improvements in the learning environment and ensure student wellbeing.

This project sought to support Splash in improving its existing water distribution system within schools through the integration of a chlorination option. Research was conducted to identify the various chlorination options on the market, and this was superimposed with the available topographical data to identify the design parameters. An inline chlorination tap for the water system was then designed, and chlorine decay modeling was performed to monitor the water quality. This was followed by the design of a tool for digitizing the Free Residual Chlorine levels in the water. This project yielded CAD drawings, water quality models, and a brief instruction manual on how to perform inline chlorination modeling in EPANET.

Outcome: Design of an inline chlorination system for water supply in schools in Ethiopia.

Schoolchildren show dirty water and filtered water
Attribution: Splash



Inline chlorinator design
Attribution: Denis Owarugambwa

Fellow:
Denis Owarugambwa, Uganda

Expert Fellow:
Hamisa Rizgallah, Kenya

Partner collaborators:

- Henok Wolday, Quality and Assurance Manager, Ethiopia

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
Splash
Technology/ Techniques used:
Autodesk Civil 3D, AutoCAD, Autodesk Construction Cloud (ACC), EPANET

Splash

AUTODESK FOUNDATION

6 CLEAN WATER AND SANITATION

UNHCR

Technical Design Support to Enhance Delivery of Sustainable Water Services to Displaced Populations

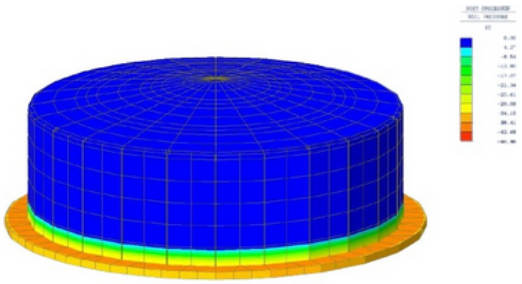
Annually, millions are compelled to leave their homes due to conflicts, violence, and persecution. With a global reach, the United Nations High Commissioner for Refugees (UNHCR) takes on the crucial role of providing international protection and seeking permanent solutions for the problem of refugees by assisting governments and partners. Notably, the UNHCR also ensures equitable access to safe water, sanitation, and hygiene, advocating for both refugees and host communities.

This project sought to support UNHCR in enhancing its ability to deliver sustainable Water, Sanitation, and Hygiene (WASH) services in refugee settlements. As a continuation of the previous cycle of the E4C Fellowship, this cycle focuses on the review, development, and improvement of existing water supply systems designs, templates and accompanying documentation.

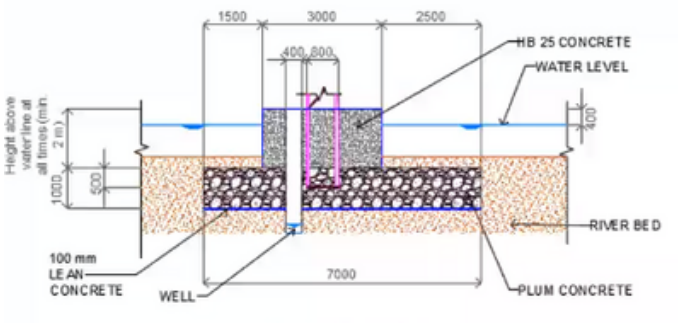
Additionally, technical drawings were produced, which facilitate missions of multi-use water supply tools that emphasize synergies between displaced settings, both within emergency and protracted situations.

Furthermore, with the increased importance of sustainable development, research was conducted on good practices for climate-resilient WASH infrastructure, and a detailed example was designed to serve as a benchmark for future WASH infrastructure designs.

Outcomes: Climate resilient WASH infrastructure report and sample design to enhance services in refugee settlements.



Structural analysis and design of a ferrocement water tank
Attribution: Sheilla Apio



2D drawing of a protection system for wells in wadis
Attribution: Sheilla Apio

Fellow:
Sheilla Constance Apio, Uganda

Expert Fellow:
Hamisa Rizgallah, Kenya

Partner collaborators:
- Fidelis Folifac, WASH Officer, Technical Support Section, UNHCR Geneva

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
UNHCR
Technology/ Techniques used:
Autodesk AutoCAD

UNHCR The UN Refugee Agency

AUTODESK FOUNDATION

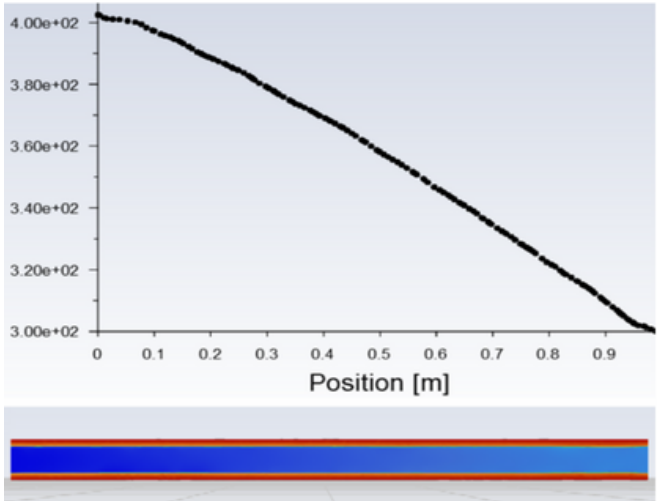
6 CLEAN WATER AND SANITATION

Beyond The Dome

Simulations for Supercritical Water Oxidation Technology

Sewage is a worldwide issue, primarily consisting of 99% water that carries various domestic wastes. These wastes originate from activities such as kitchen use, bathing, laundry, and the disposal of human waste. Sewage also contains toxic organic contaminants, including substances like PFAS (per- and polyfluoroalkyl substances), which pose environmental and health concerns.

High energy consumption and operating costs have, to a great extent, restricted the successful commercialization of the Supercritical Water Oxidation (SCWO) process.



Guidance plot for optimization of geometry
Attribution: Yaman Sahu

Therefore, the objective is to implement design modifications that facilitate the effective preheating of the inlet of reactants by utilizing the heat generated by the reactor.

Beyond the Dome is developing SCWO technology to provide treatment for biosolids and harmful organics, transforming them into non-toxic substances and water.

This project aimed to reduce the energy intensity of the process by utilizing the heat generated by the reactor to preheat the biosolids. The goal was to optimize the design in order to minimize pressure loss during the preheating and flow stages. Additionally, the project involved conducting heat transfer analysis to optimize the preheating process for biosolids or solids before introducing them into the reactor while also optimizing the reactor diameter based on the pressure head loss within. This was achieved through several computational fluid dynamics simulations, iterating variables that allow for a better understanding of the process and ways to improve it.

Outcome: Pressure and temperature simulations to optimize the design of SCWO technology for waste treatment.

Fellow:
Yaman Sahu, India

Expert Fellow:
Jorge Bravo, Ecuador

Partner collaborators:
- Matt Stroud, Co-founder, USA

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
Beyond the Dome
Technology/ Techniques used:
Autodesk Inventor, Autodesk CFD

beyond the dome

AUTODESK FOUNDATION

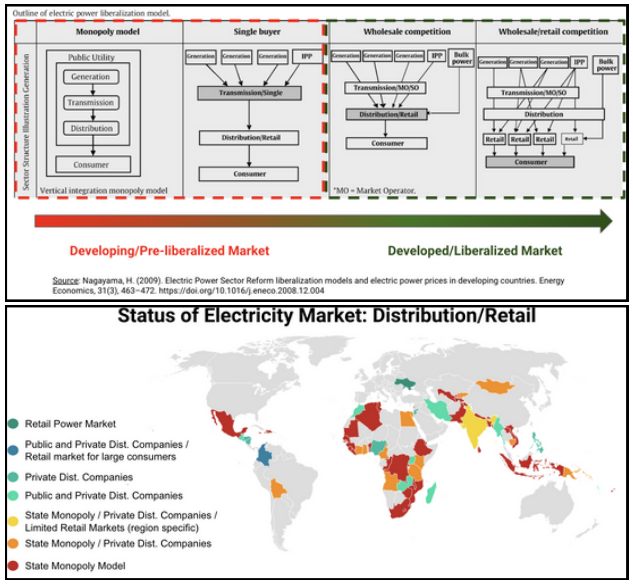
7 AFFORDABLE AND CLEAN ENERGY

Arizona State University

Electricity Markets and Policy

The objective of this project was to support the Laboratory for Energy and Power Solutions (LEAPS) at Arizona State University (ASU) to study regulations, policies, and areas of opportunity for utility business model change. The research focused on electricity markets in lower-middle income, and select low- and upper-middle income countries to liberalize existing electrical utilities.

The first task involved performing a strategic electricity market review to develop a country repository and document database covering 30+ attributes for 73 countries along with 300+ resource/reference documents.



Electricity market status
Attribution: Dilraj Singh Mann

Simultaneously, a preliminary metric framework for assessing the candidature of countries surveyed for utility business model change was developed. The metrics were chosen to holistically capture and gauge countries' potential for effective business model change intervention. Lastly, opportunities for LEAPS to collaborate with international agencies and other academia/industry-based laboratories, along with potential funding streams, were identified to leverage the lab's expertise in global energy access and grid modernization projects.

It was found that electricity markets in lower-middle countries around the world are predominantly modeled along vertically integrated structures under state control. The resultant lack of competition results in stifled innovation, monopolization, higher costs, and restricted consumer choice. Liberalization of the electricity markets is recommended as it promotes private sector participation and increases operational efficiency, leading to greater energy security, affordability, and end-user agency.

Outcomes: Accelerated identification of candidate countries for project deployment and optimal investment of the lab's time resources.

Fellow:
Dilraj Singh Mann, India

Expert Fellow:
Kithinji Muriungi, Kenya

Partner collaborators:

- Elena van Hove, Director of Global Energy Access at LEAPS, USA
- James Nelson, Director of Technology and Innovation at LEAPS, USA

This work was supported by:
Arizona State University

This work is in collaboration with:
LEAPS, Arizona State University

Technology/ Techniques used:
Google Sheets, Excel, Database

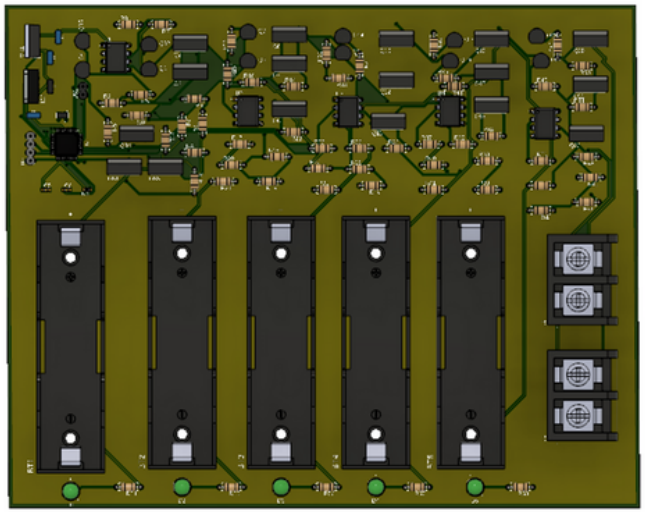
Arizona State University

7 AFFORDABLE AND CLEAN ENERGY

Solaris Offgrid

Solar Home System Reusable Smart Battery Module

The objective of this project was to support Solaris Offgrid to develop a Solar Home System Reusable Smart Battery Module for use in rural Africa and other places where there is no or limited access to the energy grid. Solaris Offgrid aims to accelerate clean energy access to rural homes while reducing the generation of e-waste associated with the use of lithium-ion battery-powered systems. This reusable smart battery module allows end users to gain access to more reliable energy due to the extended battery life duration and overall lower costs (by over 45%).



PCBA design: Reusable Smart Battery Module
Attribution: Obiuwevwi Lawrence

This project's scope included diverse phases of electronics product development. The project began with researching and understanding the concept of lossless cell balancing of lithium-ion battery cells and a review of previous literature related to the project design. Work was conducted on the design of electronic schematics and printed circuit board (PCB) layouts, simulation of design circuits, and assembly of printed circuit board assembly (PCBA) in accordance with the design specifications. The project design focused on key sections, including the control unit, a bypass switching section, and voltage measurement sections. Each of these serves a crucial role in the reusable smart battery module's overall functionality.

At the end of the project, design data (Gerber files), project documentation, a list of electronics components, and their relevant data were generated and shared with the Solaris Offgrid team in order to proceed to the prototyping phase of the project.

Outcome: Design and simulations for reusable smart battery module components to improve quality, reliability, and product performance.

Fellow:
Obiuwevwi Lawrence, Nigeria

Expert Fellow:

Kithinji Muriungi, Kenya

Partner collaborators:

- Claudio Shawawreh, Project Manager, Spain
- Ulysses De Waegemaeker, UI Designer, Spain

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Solaris Offgrid

Technology/ Techniques used:
Autodesk Fusion 360 Electronics

SOLARIS OFFGRID

AUTODESK FOUNDATION

7 AFFORDABLE AND CLEAN ENERGY

ASME & One Point Five

Fossil Fuel Industry Workforce Development for a Net Zero Energy Transition

The energy sector is responsible for approximately three-quarters of the global greenhouse gas emissions, with the oil and gas industry contributing nearly 15% to the overall emissions. As a result, there is an urgent need for the oil and gas industry to undergo energy transitions and implement different climate solutions to significantly reduce their emissions and contribute to climate change mitigation. However, a key challenge emerging from this transition is the scarcity of a skilled workforce to successfully implement, operate, maintain, and optimize the different climate solutions. New programs of education, certification, and vocational training, along with targeted upskilling or reskilling programs for the existing workforce in the oil and gas industry, will be pivotal in seizing the energy transition opportunities.

Oil & Gas industry
Attribution: Pixabay

This project aimed to support ASME's business development strategy to design and deploy new workforce development programs aligned with ASME's climate action strategy. This research informs a robust pilot, taking into consideration the cost, time to implement, complexity, and potential revenue and climate impacts of such programs. Desk research and interviews were conducted to identify key trends, market gaps, and landscape analyses within oil and gas workforce upskilling. A preliminary market size analysis of selected courses was conducted, and a go-to-market strategy was developed.

The research generated valuable insights and proposed next steps that will assist ASME in expanding and diversifying its Learning and Development services, specifically those aimed at upskilling or training the oil and gas workforce to help address climate change.

Outcome: Landscape analysis of workforce upskilling required for the energy transition in the oil and gas sector.

Fellow:
Eric Jaloff,
Argentina

Fellow:
Lesego Mohlala,
South Africa

Expert Fellow: Ana Trujillo, Colombia

Partner collaborators:

- Iana Aranda, Senior Director - ASME, USA
- Matthias Muehlbauer, Founding Partner - OPF, USA

This work was supported by:
ASME

This work is in collaboration with:
One Point Five

Technology/ Techniques used:
Qualitative Research

ONE POINT FIVE

ASME
SETTING THE STANDARD

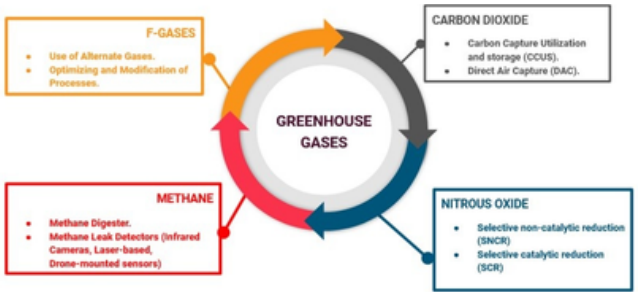
7 AFFORDABLE AND CLEAN ENERGY

ASME & One Point Five

Greenhouse Gas Related Codes & Standards

ASME's Climate Action Initiative addresses the urgent global imperative to reduce greenhouse gas emissions. This effort involves a multifaceted approach that combines both established and innovative strategies. Specifically, it focuses on mitigating methane emissions within the oil and gas sector, advancing Direct Air Capture (DAC) technologies for CO2 removal, and investigating methods to reduce the widespread use of chlorofluorocarbons (CFCs) in global HVAC systems.

This project entailed thorough market research and landscape analysis to help support these goals. The objective was to formulate essential guidelines, codes, and standards that will regulate the adoption and implementation of these technologies, ensuring that they are effective, safe, and economically viable.



Key technologies to mitigate GHG emissions
Attribution: Ambrish Kumar, Ibitoye Ayotunde

The primary goal of this project was to identify opportunities for ASME to expedite the global transition towards a net-zero energy future. Three key areas were emphasized:
1) Developing codes and standards for technologies designed to reduce methane emissions within the oil and gas sector;
2) Supporting the advancement of carbon capture and Direct Air Capture (DAC) technologies for removing and storing carbon dioxide;
3) Formulating codes and standards to govern CFC usage in HVAC systems on a global scale.

This project intended to pinpoint existing gaps and opportunities where ASME can assume a pivotal role. In doing so, ASME aims to contribute substantially to global sustainability efforts.

Outcome: Recommendations to advance the transition to a net-zero future through codes and standards.

Fellow:
Ambrish Kumar, India

Fellow:
Ibitoye Ayotunde, Nigeria

Expert Fellow: Ana Trujillo, Colombia

Partner collaborators:

- Iana Aranda, Senior Director - ASME, USA
- Matthias Muehlbauer, Founding Partner - OPF, USA

This work was supported by:
ASME

This work is in collaboration with:
One Point Five

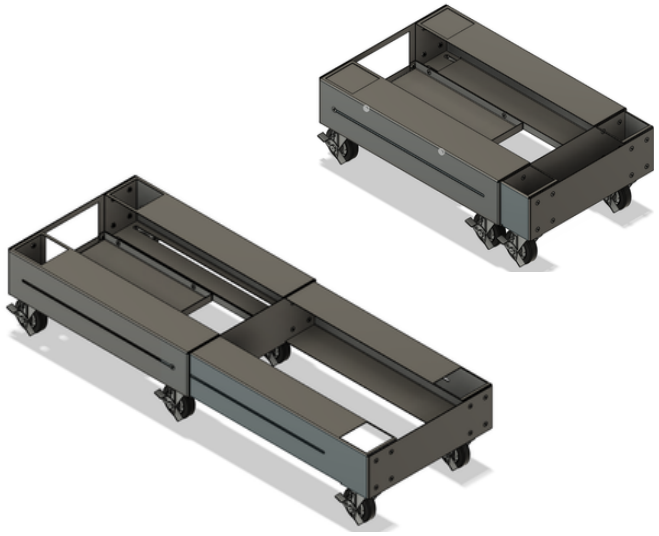
Technology/ Techniques used:
Qualitative Research

7 AFFORDABLE AND CLEAN ENERGY

Koolboks
Redesign of Powerfoot Pedestal

Koolboks' mission is to make cooling affordable, accessible, and sustainable for everyone who needs it. This has led to the development of the unique features of the Koolboks refrigerator.

The Powerfoot is one of the essential components of Koolboks' refrigerator that supports its weight; it houses the battery, elevates the refrigerator from ground level, and provides robust wheels for portability. However, there is room for improvement to reduce Powerfoot's cost of production, enhance its quality, and make adaptable to different refrigerator sizes.



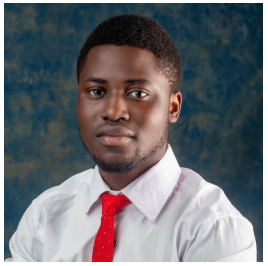
The Powerfoot pedestal redesign assembly
Attribution: Philemon Adeyemi

This project aimed to redesign the Powerfoot pedestal to increase its durability and reduce the costs of the structure. There was also a need to develop an extendable pedestal that could be used with the full range of sizes of Koolboks products. These improvements would be made by analyzing the existing design, proposing modifications and producing models and drawings.

The Fellow started by evaluating and modeling the existing solutions to identify opportunities for reducing cost and increasing durability in the redesign. The Fellow also explored design modifications to extend the pedestal while maintaining structural integrity. The final concept was iteratively refined by simulation and stakeholder feedback to achieve the desired specifications.

The final Powerfoot Pedestal design was presented in CAD form, including engineering drawings, computational models, and animations. A report detailing the design process was also completed.

Outcome: Redesign of solar refrigerator pedestal to improve durability, affordability, and adaptability.



Fellow:
Philemon Adeyemi, Nigeria

Expert Fellow:
Joseph Kurebwa, Zimbabwe/UK

Partner collaborators:

- Akeem Azeez, Lead Engineer IoT Department, Nigeria
- Natalie Casey, Chief Business Officer, France

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Koolboks

Technology/ Techniques used:
Autodesk Fusion 360

KOOLBOKS LIFE IS KOOL

AUTODESK FOUNDATION

7 AFFORDABLE AND CLEAN ENERGY

Okra Solar

Mechanical Design for Mesh Grid Power System Components

The prevailing energy access disparity predominantly affects low- and middle-income countries, with a significant proportion of energy-deficient areas falling within this category. The projected impact of unreliable energy access is substantial, particularly in Sub-Saharan Africa. It is estimated that approximately 600 million people - 57% of the population - live without electricity. This challenge stems from a combination of factors such as rapid population growth, urbanization, and the introduction of novel technologies, collectively posing unprecedented obstacles to ensuring consistent and adequate energy access.

Conceptual design rendering of enclosure
Attribution: Okra Solar

The aim of Okra Solar is to deploy cost-effective and affordable solar-based energy solutions to energy-constrained regions, and this project seeks to support this goal by adopting a more streamlined method of deploying Okra Mesh Grid products through the design of a simple plug-and-play unit integrated within an enclosure. This project also seeks to develop a framework for mass-produced enclosures with lower cost per unit.

The project started with a conceptualization of the enclosure, followed by the design and prototyping of the unit for the Okra Mesh grid product. Manufacturers and vendors were consulted to ensure a manageable cost per unit enclosure was achieved. Materials such as CAD drawings, production files, assembly instructions, and renderings were created to support manufacturing and installation. This allowed for the development of prototypes, which were deployed in the field and tested by the team and users to gather feedback and plan improvements for future designs.

Outcome: Designs and prototypes developed to streamline the deployment of affordable solar-based energy solutions.

Fellow:
Akeem Adams,
Nigeria

Expert Fellow:
Hamisa Rizgallah, Kenya

Partner collaborators:

- Oscar Aitchison, Product Manager, USA

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Okra Solar

Technology/ Techniques used:
Autodesk Inventor, Nastran, AutoCAD

OKRA AUTODESK FOUNDATION

7 AFFORDABLE AND CLEAN ENERGY

Delta40 & Factor[e] Ventures

Improving Small Genset Efficiency in Nigeria

Nigeria faces a significant energy crisis, with 60-70% of its population living without regular electricity access. Many Nigerians rely on petrol generators to meet their electricity needs, with annual grid electricity consumption per capita being 30% of the Sub-Saharan African average. The importation of generators into the country is not properly regulated, and customers often run their gensets at a 20-30% load factor, which leads to higher fuel consumption, costs, and emissions. In addition to this, the government proposed the removal of fuel subsidies by 2023, which could lead to adulterated fuel flooding the market.

Delta40 powerstrip solution
Attribution: Pixabay and Payan Ole-MoiYoi

Delta40 aims to design and propose a low CAPEX solution to make existing gensets more efficient and bridge the gap between inefficient use and lack of access to renewable/battery-based solutions. The project aims to decrease the OPEX of running gensets by 50% by improving system efficiency and integrating extra layers for usage monitoring.

Key highlights of the project include developing recommendations for optimizing existing solutions to reduce climate impact, improving energy access, addressing customer pain points, increasing energy education, and proposing an independent power supply. Delta40 aims to make significant strides toward improving energy access, reducing emissions, and fostering sustainable economic growth.

Outcome: Proposal for fit-for-purpose energy access solution to improve the efficiency of small gensets in Nigeria.

Fellow:
Samuel Oladele Olu-Alaofin, Nigeria

Expert Fellow:
Deji Adebayo, Nigeria

Partner collaborators:

- Payan Ole-MoiYoi, Product & Industrial Design Director, Kenya
- Justice Eyo, Research Engineer, Nigeria

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Delta40, Factor[e] Ventures

Technology/ Techniques used:
Autodesk Inventor, KoboToolbox, Maya

FACTOR[e] VENTURES

AUTODESK FOUNDATION

Delta 40
A STUDIO AT FACTOR/E

8 DECENT WORK AND ECONOMIC GROWTH

Ampersand E-Mobility

Enclosure Design for Electric Motorbike Battery Pack

Transportation is a major source of greenhouse gas emissions in Africa, accounting for 40% of the continent's total. Without mitigation measures, this sector will emit 7.1 gigatons of carbon dioxide equivalent per year by 2050, which would have serious consequences for the climate and the environment. Alongside this, motorcycle taxi drivers face the challenge of maintaining their income as gas prices rise.

Ampersand aims to address both pollution and taxi driver income challenges with e-motorcycle solutions. These can boost taxi drivers' annual earnings by 35% while minimizing greenhouse gas emissions. Ampersand's latest solution aims to achieve this while minimizing the disruption to driver routines with an improved battery pack enclosure design that improves the user experience, durability of the battery pack enclosure, and swapping mechanism.

The current battery (yellow) swapping system
Attribution: Cindy Jinhee Park

This project aimed to assist the Ampersand team in the design development of a new battery enclosure, mounting mechanism, and locking mechanism. A holistic approach was required, accounting for manufacturing considerations and user experience for drivers and swap station service providers.

The Fellow researched and developed design ideas for various aspects of the battery enclosure and its related mechanisms, such as cooling and swapping. The battery cell arrangement was also optimized to reduce the required enclosure volume, and detailed designs were developed for assembly. Mounting and quick-release mechanisms for the battery enclosure were creatively conceptualized with the team, and suitable manufacturing methods were determined.

Outcome: Conceptual design developed for e-motorcycle components to improve durability and user experience.

Fellow:
Cindy Jinhee Park, Korea/Canada

Expert Fellow:
Joseph Kurebwa, Zimbabwe/UK

Partner collaborators:

- Taiei Harimoto, Lead Mechanical Engineer, Rwanda

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Ampersand E-Mobility

Technology/ Techniques used:
Autodesk Vault, Autodesk Inventor, Autodesk Fusion 360

AMPERSAND

AUTODESK FOUNDATION

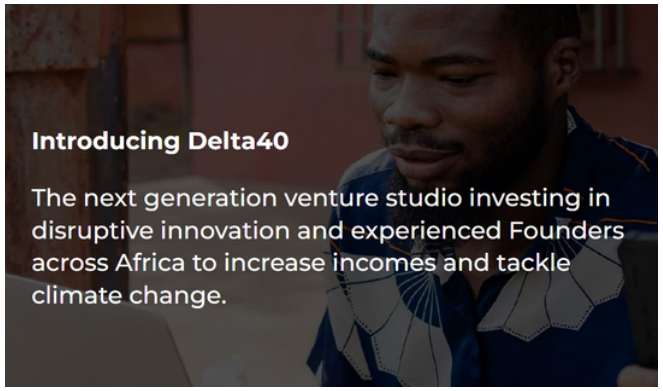
8 DECENT WORK AND ECONOMIC GROWTH

Delta40 & Factor[e] Ventures

Improving Tools and Processes for Venture Building

Delta40 Venture Studio aims to increase incomes and tackle climate change in Africa by building and investing in technology-enabled energy, agriculture, and mobility ventures. In the studio, they focus on building ventures with diverse and experienced founders with speed and scale. Delta40 has a portfolio of innovative ventures in Africa that transform founders' and customers' lives, amplify the entrepreneurial ecosystem across the continent, deliver returns to investors, and tackle climate change.

The primary objectives of the project were to support Delta40 in: aggregating existing tools and systems for venture building; organizing, structuring, improving the tools and templates; and developing new processes in collaboration with the venture studio team.

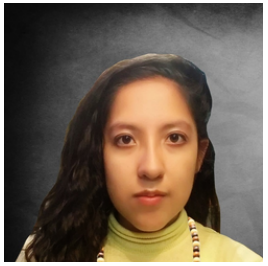


Delta40 venture studio introduction
Attribution: Delta40 Venture Studio

Desk research was conducted into Delta40's workflow, current tools, and processes. To identify opportunities for improvement, standard tools, and processes used by similar organizations globally were investigated. Data was gathered and supported the development of a database of venture studios, with a particular focus on the African continent.

The Fellow also contributed to creating a slide deck for the HR onboarding process, a deck on the venture studio insights, and co-founder programming insights. A comprehensive report, including slide decks, documents, and database spreadsheets, has been produced for the Delta40 team to implement the findings in its programs.

Outcome: Materials developed to support the growth of venture studios and founders.



Fellow:
Valeria Cerpa,
Peru

Expert Fellow: Tanvir Khorajiya, India

Partner collaborators:

- Payan ole-MoiYoi, Product & Industrial Design Director, Kenya
- Helidah Wagude, Business Analyst/Research Fellow, Kenya
- Christine Otieno, Design Research Analyst, Kenya

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Delta40, Factor[e] Ventures

Technology/ Techniques used:
Google Suite

FACTOR[e] VENTURES

AUTODESK FOUNDATION

Delta 40
A STUDIO AT FACTOR/E

8 DECENT WORK AND ECONOMIC GROWTH

ASME FutureME

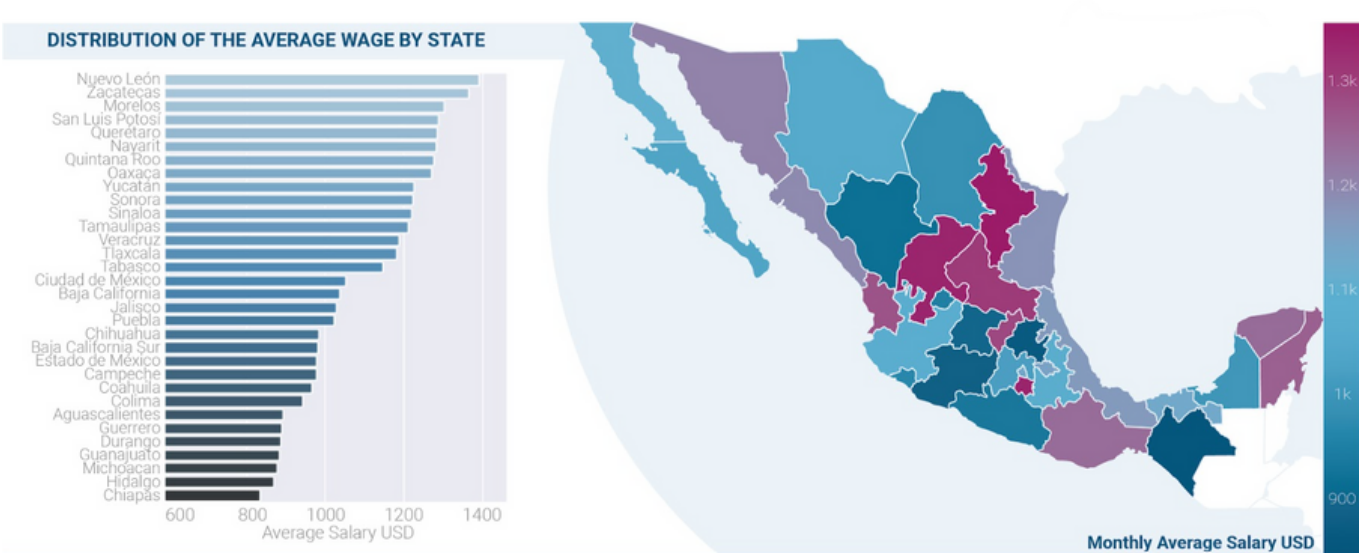
Mexico Data Set for Careers Platform

The FutureMe Platform focuses on early career engineers who are looking for career analytics or to polish their skills, aiming to equip them with the knowledge and tools they need to make career decisions. The platform offers insightful information about a specific region's labor market, providing insights into occupations, salary trends, and current or future technical information.

Having successfully developed databases for the USA and India in the past, ASME now wants to develop a comprehensive database for the engineering field in Mexico.

Fellows supported the development of the platform by identifying datasets for employment in Mexico, researching potential career roadmaps for mechanical engineers, and collecting data related to occupation, workforce, and salaries. Data was pulled from job websites to extract current salaries, analyze monthly and hourly wages, and calculate dollar conversions and location quotients.

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



Excerpt from infographic
Attribution: Comfort Tenjier, Fernanda Moscoso

Fellow:
Comfort Tenjier, Ghana

Fellow:
Fernanda Moscoso, Spain

Expert Fellow:
Deji Adebayo, Nigeria

Partner collaborators:

- Nida Ahmed, Program Manager, EFx, USA
- Serosh Shahid, Director, USA

This work was supported by and in collaboration with:
ASME

Technology/ Techniques used:
Python, Excel, Jupyter Notebook

ASME
SETTING THE STANDARD

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Bridges to Prosperity

Development of a Rural Transport Infrastructure Planning Matrix

Globally, more than 1 billion people suffer from rural isolation and lack safe access to critical services, representing a staggering 1 in 7 individuals who cannot reach vital resources. This issue is exacerbated by a lack of knowledge among local and district engineers in underserved communities when it comes to selecting suitable river crossing solutions for their specific contexts. While engineers in the Global North benefit from a wealth of resources such as design guides and codes of practice tailored to their climate, population density, and transportation modes, those in the Global South encounter challenges due to limited documentation on simpler, context-appropriate structures.

Bridges to Prosperity aims to address these issues, envisioning a world where poverty caused by rural isolation no longer exists.

Matrix tool welcome page
Attribution: Bridges to Prosperity and Mwendwa Kiko

This project's primary goal was to evaluate various river crossing structures suitable for rural transportation contexts, encompassing cable-suspended bridges, stone arch bridges, and culverts, across a range of criteria like life cycle cost, span, and climate resilience. The project's culmination was the creation of a matrix tool accessible to infrastructure planners, aiding in the selection of the most appropriate river crossing structure based on a given set of inputs.

The key tasks involved comprehensive desk research on diverse river crossing structures and the relevant evaluation criteria. This led to the development of an interactive web app, built primarily using Python with the Streamlit library, enabling users to assess specific bridge sites according to the identified criteria.

This tool will help in addressing the infrastructure challenges faced in isolated communities, facilitating the creation of context-appropriate river crossing solutions, and improving access to critical services for millions worldwide.

Outcome: Matrix tool developed to inform the selection of crossing structures in rural transportation contexts.

Fellow:
Mwendwa Kiko, Kenya

Expert Fellow:
Maël Sonna, Cameroon

Partner collaborators:

- Alex McNeill, Vice President of Advisory Services, Rwanda
- Alan McGrane, Director of Engineering, France

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Bridges to Prosperity

Technology/ Techniques used:
Python (Streamlit)

Bridges to Prosperity

AUTODESK FOUNDATION

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

The Autodesk Foundation

Promoting Portfolio Organizations to Increase Impact

The Autodesk Foundation, a philanthropic arm of Autodesk, Inc., supports the design and creation of innovative solutions to the world's most pressing challenges. It uses grants and impact investments, donated Autodesk technology, and Autodesk employee volunteer hours to support non-profits and start-ups to scale innovations - advancing a more sustainable, resilient, and equitable world.

A snapshot of article on Amped Innovation's technology.
Attribution: Autodesk

The investments are focused on Autodesk's three impact opportunity areas: Energy and Materials; Health and Resilience; and Work and Prosperity. Given the complexity of the issues addressed, there is often an overlap in impact outcomes across these impact opportunity areas.

This project aimed to promote how organizations in The Autodesk Foundation's portfolio are using Autodesk software and talent to further their impact. It also sought to amplify the stories of portfolio organizations, inspire others to develop innovative solutions to global issues, and attract organizations to The Autodesk Foundation portfolio.

The Fellow uncovered how the portfolio organizations are using Autodesk technology to create and scale impact outcomes. Complex information was distilled into story leads, and desk research was conducted before interviewing key stakeholders. The fellow also pitched stories to Autodesk outlets and, when applicable, wrote stories on the intersection of technology and impact outcomes. Finally, the fellow identified and reported on insights and trends about how Autodesk software is being used for impact.

Outcome: Approximately 60 story leads, 10 briefs, 4 stories, and 15 trends and insights covered to advance the philanthropic work of The Autodesk Foundation.

Fellow:
Elizabeth Laughlin, USA

Expert Fellow:
Joseph Kurebwa, Zimbabwe/UK

Partner collaborators:

- Alli O'Connell, Head of Marketing & Communications, USA

This work was supported by and in collaboration with:
Autodesk Foundation
Technology/ Techniques used:
Product Design & Manufacturing, Architecture, Engineering, and Construction Collections

AUTODESK FOUNDATION

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Build Health International

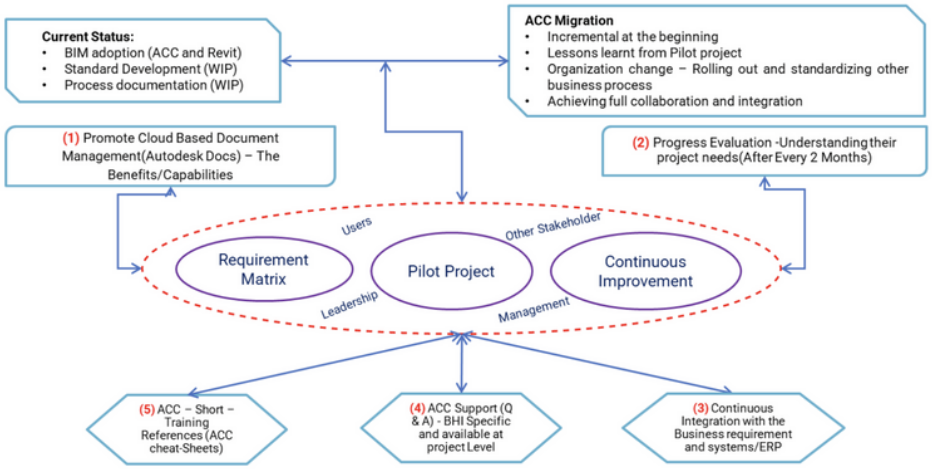
Development of Integrated Design & Engineering Workflow

The aim of this project was to improve and expand Build Health International (BHI) workflows between the global integrated architectural, engineering, and project management teams.

This project specifically sought to analyze existing processes that BHI currently utilizes (Autodesk Construction Cloud, Revit, Civil 3D, etc.), conduct research to determine which BIM processes best fit BHI's current workflows, and identify strategies to better implement and improve them. Workflows were also created to ease the transfer of information from one platform to another (i.e., from BIM Authoring Tools like Revit to Autodesk Construction Cloud).

Previous and existing systems were reviewed with respect to: communication channels; processes/tools to produce deliverables; and project information management (reports, deliverables and documentation). Gaps were identified using a case study of a project in Nigeria and conducting interviews with the BHI team to understand experiences and lessons learned. The information was then synthesized to identify key issues and proposals. This will help in better design and construction management coordination and improving quality and reliability.

Outcome: Recommended solutions to improve workflows for increased efficiency in BHI's processes.



Analysis of existing BHI workflow
Attribution: Obed Kiprotich Bore

Fellow:
Obed K Bore,
Kenya

Expert Fellow: Radhika Mundra, India

Partner collaborators:

- Sarah Sceery, Deputy Director - Partnerships and Administration, USA
- Alejandro Ascuasiati, BIM Manager, USA
- Fatlum Troshani, Project Engineer, USA

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
Build Health International

Technology/ Techniques used:
Autodesk Construction Cloud, Revit

Build Health International

AUTODESK FOUNDATION

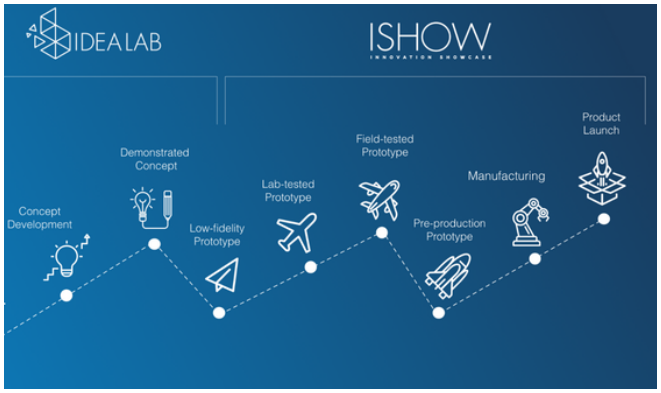
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

ASME Idea Lab

Workflow Improvements for ASME Idea Lab Incubator

Idea Lab is an incubator offering comprehensive support to social entrepreneurs throughout the initial stages of product development, from early-stage ideation to developing low-fidelity prototypes. Idea Lab offers a platform where innovators focused on hardware-led innovations receive mentorship, training, and seed capital while employing an approach where participants not only refine their technical skills but also gain a profound understanding of market dynamics, user needs, and scalable business models.

This preparatory phase acts as a stepping stone for these entrepreneurs to increase their likelihood to potentially transition into the ASME ISHOW accelerator ecosystem, where their projects are elevated to the market-ready stage, effectively scaling up their impact.



Idea Lab Tech Development Milestones
Attribution: ASME

Through this project, ASME Idea Lab sought to gain insight from a retrospective analysis of its inaugural year in order to effectively streamline stakeholder engagement processes, revise the program structure, and improve offerings to future innovators and mentors in anticipation of the Idea Lab 2.0 launch.

The Fellow worked closely with the Idea Lab team in assessing insights from the post-mortem analysis on Idea Lab 1.0 in order to identify the research scope and areas of refinement. Processes for communication were streamlined between stakeholders (e.g., innovators and mentors). Furthermore, research was conducted, and recommendations were made on: how to improve the retention of information between mentors and innovators; benchmarking and tracking of progress; and a formalized process for mentor recruitment.

Outcome: Report comprising workflow improvement recommendations for incubator advancing social impact.

Fellow:
Paula Kworekwa, Uganda

Expert Fellow:
Tanvir Khorajiya, India

Partner collaborators:

- James Creel, Senior Program Manager, ASME, USA
- Adam Horbinski, Senior Product Designer, USA

This work was supported by:
ASME

This work is in collaboration with:
ASME Idea Lab

Technology/ Techniques used:
Qualitative Research

ASME | IDEALAB

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

ASME ISHOW

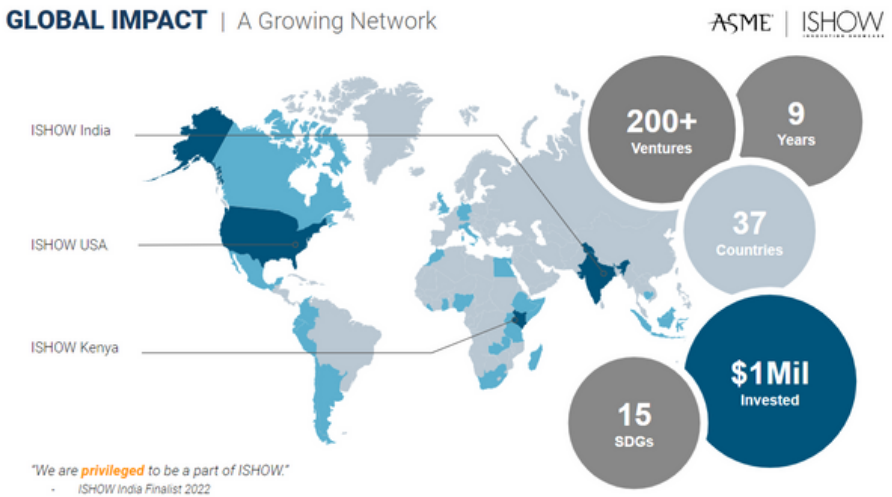
ASME ISHOW Longitudinal Study on Social Return on Investment

ASME ISHOW, an accelerator of hardware-led social innovation, has supported the entrepreneurial ecosystems in India, Kenya, and the United States since 2015. Research conducted by E4C Fellows over recent years helps ISHOW assess its impact on communities and the entrepreneurial ecosystems and ventures it supports.

This project aimed to support ISHOW's internal data collection and Social Return on Investment (SROI) initiatives for past applicants, finalists (ISHOW regional), and winners (ISHOW Bootcamp). Specifically, this research contributed to an ongoing longitudinal study to collect and analyze both qualitative and quantitative data on ISHOW's impact on early-stage startups and innovation ecosystems.

Working on this project, the Fellow conducted various interviews and surveys with past ISHOW finalists and winners. Consequently, the data collected were analyzed, synthesized, and integrated into the previous years' findings to help visualize and measure ISHOW's cascading impacts. The fellow also worked on determining the difference between pre- and post-ISHOW capacities and confidence levels in ventures. At the end of the Fellowship, a detailed report comprising an analytical database of the ISHOW's impact on ventures was presented to the ISHOW team.

Outcome: Survey and data collection to assess and advance the impact of ASME ISHOW.



ASME ISHOW global impact
Attribution: ASME ISHOW

Fellow:
Victor Ticllacuri, Peru

Expert Fellow:
Tanvir Khorajiya, India

Partner collaborators:
- James Creel, Senior Program Manager, USA

This work was supported by:
ASME
This work is in collaboration with:
ASME ISHOW
Technology/ Techniques used:
Qualitative Research

ASME | ISHOW INNOVATION SHOWCASE

10 REDUCED INEQUALITIES

Engineering Change Lab

Supporting a Racial Justice Initiative for Urban Development and Infrastructure in the US

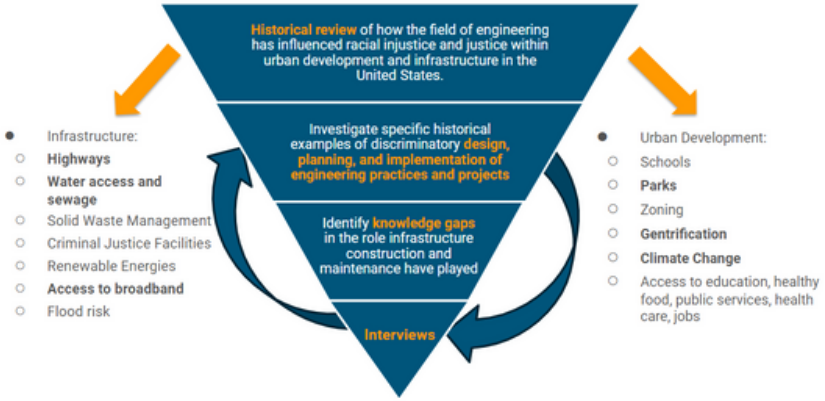
Understanding the role of engineering practices in perpetuating historical injustices is crucial for creating informed policies and interventions that address systemic inequalities and work toward a more equitable future.

Although there is extensive research available on redlining practices, the Federal Housing Act, the Highway Act, and Urban Renewal Programs, there has been comparatively less focus on the contribution of engineering practices and engineers themselves in historically perpetuating these injustices. This gap in understanding has led to a limited awareness of the enduring impact of these practices on present-day inequalities.

This report aimed to support Engineering Change Lab-USA in exploring the impact of engineering practices on racial equity in various domains, such as transportation systems, water infrastructure, broadband access, gentrification, park accessibility, and climate change. A historical review was conducted into how the field of engineering has influenced racial injustice and justice within urban development and infrastructure in the United States.

This project will contribute towards a larger Pilot Project for engineering practice related to urban development, housing, and infrastructure with a targeted community. Exploring the specific ways in which engineering practices have contributed to racial injustice.

Outcome: Report with recommendations for addressing racial disparities in urban development.



Research scope
Attribution: Ana Velastegui

Fellow:
Ana Velastegui, Ecuador

Expert Fellow:
Ana Trujillo, Colombia

Partner collaborators:

- Mike McMeekin, President / Executive Director, USA
- Kyle Davy, Creative Director and Lead Facilitator, USA

This work was supported by and in collaboration with:
Engineering Change Lab-USA

Technology/ Techniques used:
Qualitative Research

Engineering Change Lab USA

11 SUSTAINABLE CITIES AND COMMUNITIES

Build Change

Assessment of Housing Finance and Home Strengthening Market in Nepal

A significant portion of Nepal's population, around 78%, resides in rural areas. The National Construction and Housing Census of Nepal in 2021 has revealed that 51% of rural houses are constructed with stone/brick masonry in mud mortar, often referred to as vernacular houses. These traditional structures are non-engineered and have endured for generations. Their vulnerability was underscored by substantial damage during the 2015 Gorkha earthquake, highlighting the pressing need for strengthening and retrofitting techniques to enhance their resilience.

Vernacular house in a rural setting during on-site homeowner survey
Attribution: Mona Nakarmi

Build Change is the global leader for systems change in resilient housing, aiming to reduce deaths injuries, and economic losses caused by building collapses due to natural disasters.

This project's primary objective was to assess the housing finance and home-strengthening market in Nepal, with a specific case study in Dhungkharka. This included evaluating financing products for both new construction and renovation offered by government programs and private financial institutions. The focus was on incremental housing products, particularly for home strengthening.

Key tasks involved conducting market and cost studies through homeowner surveys to determine the number and types of vulnerable homes, financing needs, preferences, and borrowing capacity of low-income households for home strengthening. The project also examined the condition of indoor habitability in vernacular houses and assessed the willingness for improvements. Additionally, it evaluated the costs associated with quality and certified upgrades, such as retrofitting, and explored the potential for financing home strengthening through financial institutions.

Outcome: Market and cost study to identify opportunities for home strengthening in Nepal.

Fellow:
Mona Nakarmi, Nepal

Expert Fellow:
Maël Sonna, Cameroon

Partner collaborators:

- Liva Shrestha, Lead Structural Engineer, Country Representative, Nepal
- Bibek Bandhu Bhandari, Project Engineer, Nepal

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Build Change

Technology/ Techniques used:
Google Suite

BUILD CHANGE AUTODESK FOUNDATION

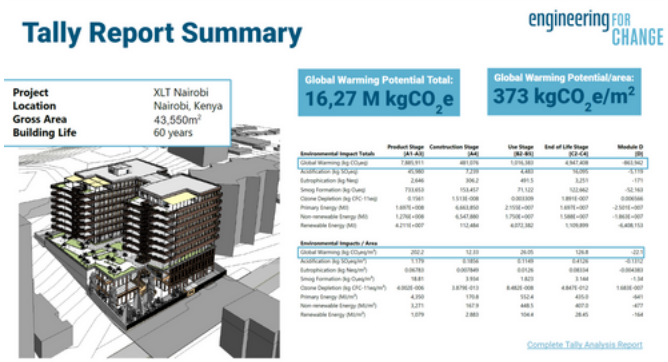
11 SUSTAINABLE CITIES AND COMMUNITIES

BuildX Studio

Advancing Behavioral Change Towards a Low-Carbon Construction Industry in East Africa

The construction industry is responsible for a staggering 39% of global carbon emissions, encompassing both embodied and operating emissions. In East Africa, mass timber processing and building represent a huge opportunity for reducing this environmental impact. Mass timber's unique ability to sequester carbon from the atmosphere when used in durable products makes it a promising alternative to carbon-intensive concrete and steel.

BuildX Studio has decided to lead a mass timber industry initiative in East Africa through the construction of its pioneering CLT Tower project in Kenya, the region's first mass timber building.



Global warming potential of CLT Tower demonstration building
Attribution: Ginani Utami

The goal of this project was to demonstrate the advantages of mass timber compared to traditional construction materials, using its demonstration building made of 19.3% timber in structure.

During the project, Autodesk Revit and Tally plug-ins were used to quantify the environmental impact of the CLT Tower through a comprehensive Life Cycle Analysis (LCA), comparing it with a conventional steel and concrete building. Additionally, the building's impact on health and well-being was evaluated by simulating indoor environmental factors like daylighting, ventilation, thermal comfort, and humidity. Furthermore, the project assessed the building's safety and performance, including the building's behavior in the event of a fire, which could be visualized through the use of Autodesk 3DS Max and FumeFX plug-in.

By providing the results of the comprehensive analysis of the CLT Tower, BuildX Studio is able to showcase the benefits of mass timber and contribute to a more sustainable approach to construction in East Africa and beyond.

Outcome: Analysis of mass timber building to understand benefits, safety, and performance.

Fellow:
Ginani Utami,
Indonesia

Expert Fellow:
Maël Sonna, Cameroon

Partner collaborators:
- Maryem Sadek, Mass Timber Initiative Manager, Kenya

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
BuildX Studio
Technology/ Techniques used:
Autodesk CFD, Tally, 3DS Max

BUILDX STUDIO AUTODESK FOUNDATION

11 SUSTAINABLE CITIES AND COMMUNITIES

Hometeam Ventures

Automated System for Venture Funding of Affordable Housing Technologies

Construction and housing are some of the world's largest but least innovative industries. Predictions suggest that three billion people will be living without access to adequate shelter by 2030. Innovation in the construction industry is necessary to close the housing gap worldwide and ensure cheaper, sustainable housing solutions. Startups are early-stage businesses with huge ideas, and they frequently demonstrate great innovation, create jobs, and introduce new technology and services that can boost the economy.

To that end, Hometeam Ventures (HTV) wants to track innovative early-stage startups and their founding members to understand their interests and form collaborations with them at an early stage. Through funding or assistance, HTV helps ensure the success of startups.

After thorough research into possible solutions that can help with collecting the data that HTV requires to scout potential early-stage startups, the Fellow identified primary objectives to target. First of all, to create Python scripts for managing the process and supporting the automation of technology scouting (e.g., web crawling/scraping). Secondly, upgrading old automation scripts to adapt to the database change from Notion to Affinity. A backend tool was also developed to work with LinkedIn APIs to extract organization data from LinkedIn search filters.

Outcome: Solutions identified for scouting early-stage construction startups who would benefit from funding and support.

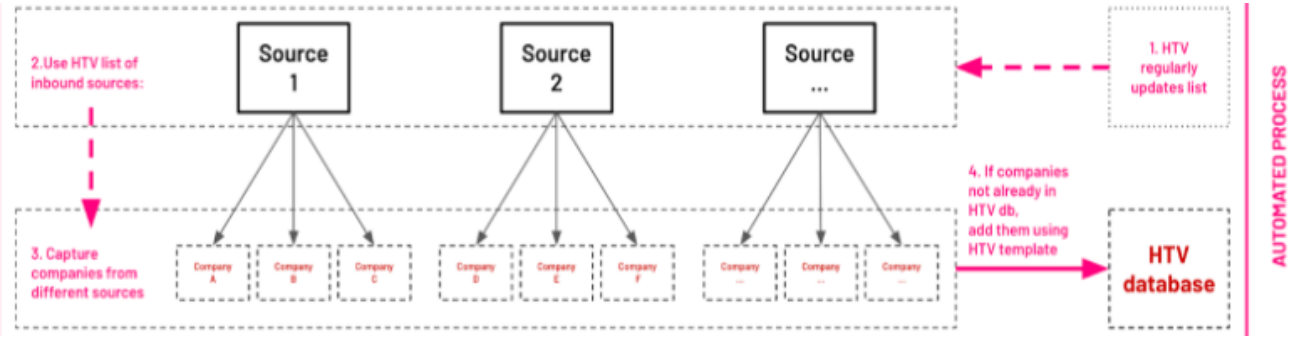
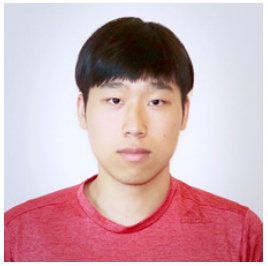


Diagram of HTV inbound sources workflow
Attribution: Zifeng Zhu



Fellow:
Zifeng Zhu, China

Expert Fellow: Arya Sarkar, India

Partner collaborators:
- Andra Stanciu, Strategic Research Lead, USA
- Alexandria Lafci, Founder and Managing Partner, USA

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
Hometeam Ventures
Technology/ Techniques used:
Google Colab, Python, Affinity, Notion, API

hometeam VENTURES

AUTODESK FOUNDATION

11 SUSTAINABLE CITIES AND COMMUNITIES

Penn State

Harnessing Digital Technologies to Empower Communities for Resilient Housing

Flooding has been a recurring problem in Pennsylvania, USA, since 1889. Predictions indicate that roughly 13% of the state's properties will encounter flooding within the next 30 years. A substantial rise in extreme temperatures is also expected, with summer temperatures projected to increase by 12.88°F and days exceeding 90°F could surge from an average of 10 to 20-30 days annually. Globally, floods from storms and extreme temperatures contribute to 41% of severe weather-related deaths. Extreme weather has also disproportionately affected racial minorities, children, the elderly, and women - who experience 14 times more pronounced impact than men. In safeguarding households from climate change's adverse effects, resilient housing plays a crucial role.

Empowering communities with digital technologies
Attribution: Romulo Martins

The main objective of this project was to uncover digital technologies that foster public awareness, offer data-driven vulnerability information to local authorities, enable financing access, streamline programs, deliver informed technical assistance, and advance equity.

The starting point of this project was researching historical data and climate change predictions related to flood and extreme heat hazards in Pennsylvania, which was followed by an investigation of households' needs, the resilient housing process, initiatives, and interactions among stakeholders within the household's path to resilient housing.

It was also important to extract insights from successful global resilient housing programs and explore the ways in which digital technologies can drive demand, creating a win-win relationship among stakeholders and streamlining the pathway to resilient housing. The result of this project is a comprehensive report that focuses on the digital technology framework, uncovering existing and new technologies that empower communities seeking resilient housing in flood and extreme heat-prone areas in Pennsylvania.

Outcome: A report investigating potential pathways to climate-resilient housing in Pennsylvania.

Fellow:
Romulo Martins, Brazil

Expert Fellow:
Hamisa Rizgallah, Kenya

Partner collaborators:

- Esther Obonyo, Associate Professor and Global Building Network Director, USA

This work was supported by and in collaboration with:
Pennsylvania State University

Technology/ Techniques used:
Qualitative Research

PennState

11 SUSTAINABLE CITIES AND COMMUNITIES

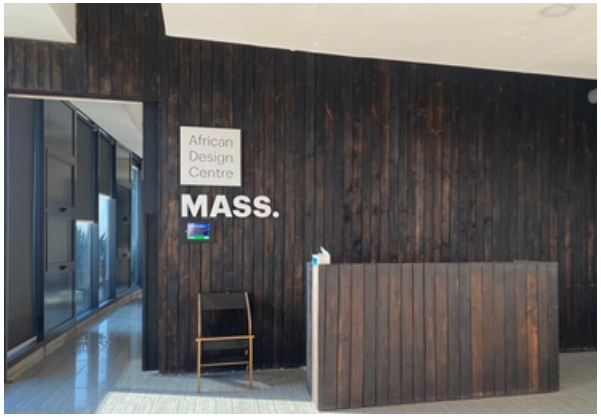
MASS Design Group

Post Occupancy Energy and Environmental Quality - Monitoring & Evaluation

Buildings don't always perform as intended. Gathering feedback from building operations can offer valuable insights that help building owners save operational energy, improve spaces and environments for occupants, and improve future designs.

For this project, Engineering for Change and MASS Design Group collaborated with Kumva to pilot an automated and scalable system in MASS's Kigali office for monitoring and evaluating energy use, indoor air quality, and comfort.

The project aimed to test the workability of the Kumva system, improve building operation, reduce energy consumption, and record lessons learned to apply to MASS's future projects.



MASS Design Group's Kigali office
Attribution: Diane Mumararungu

Relevant information was collected, including monthly electricity bills, floor plans, etc., for energy consumption. The office spaces were then modeled using EDGE and compared to the collected data. Monitoring devices were installed within the office to collect real-time data on indoor air quality, which was analyzed and compared against the internationally relevant standards.

The data were then analyzed to identify drivers of energy consumption and benchmark efficiency measures to be taken. The outcomes show that the energy consumption obtained from the EDGE assessment was similar to a typical building in the region, with data showing that approximately 40% of the office's energy consumption happens over the weekends. This led to recommendations for energy savings, such as ensuring equipment is switched off when not in use.

Further studies are recommended to obtain more data and insights on indoor temperature and CO2 levels, as well as the influence of building envelope and building use on indoor environmental quality.

Outcome: Insights on energy consumption and savings to inform future improvements and designs.

Fellow:
Diane Mumararungu, Rwanda

Expert Fellow:
Radhika Mundra, India

Partner collaborators:

- Francis Fotsing, Environmental Engineer, Rwanda
- Tilly Lenartowicz, Environmental Engineering Director, Rwanda
- Rosie Goldrick, Principal, Rwanda

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
MASS Design Group

Technology/ Techniques used:
EDGE software, Excel

MASS. AUTODESK FOUNDATION

11 SUSTAINABLE CITIES AND COMMUNITIES

MASS Design Group

Researching Performance Data & Supply Chains for Materials Library

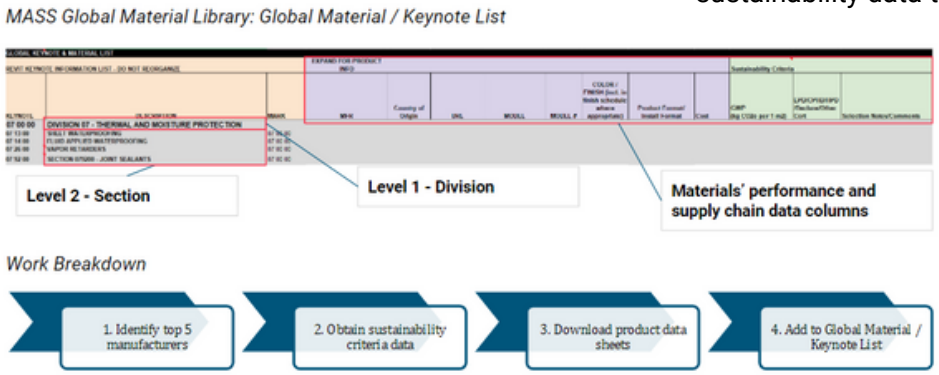
Building materials and resources all have environmental, social, and economic impacts beyond just their use phase in a project. Unless we take action soon to reduce emissions arising from construction materials manufacturing, these emissions will continue to increase. MASS Design Group's approach aims to minimize the environmental impact of construction projects. This project aimed to support MASS's Building Integrity Council in vetting materials for performance, ethics, embodied carbon, and value while building out its materials library.

The objective of this project was to investigate and categorize building materials to feed into the design process while also contributing ideas for innovative methods of codifying and organizing data to maximize the way in which teams can leverage these resources.

The Fellow investigated and suggested metrics that can be used to quantify and demonstrate the environmental impacts of the materials, methods behind selecting the right materials, and top material manufacturers.

The metrics identified included Global Warming Potential, Environmental Product Declarations, baseline values, permeance, location of production, and recycled content. The 29 manufacturers for four categories of products (sheet waterproofing, fluid-applied waterproofing, vapor retarders, and joint sealants) were researched and added to the database, along with comparison tables and data analysis. Reports were also produced on sustainability criteria and the methodology used to identify products.

Outcome: Materials library populated with sustainability data to inform product selection.



MASS Global Library template and workflow
Attribution: Jie Li

Fellow:
Jie Li, China

Expert Fellow:
Radhika Mundra, India

Partner collaborators:

- Chris Hardy, Design Director, USA
- Adam McDonald, Project Manager, USA

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
MASS Design Group

Technology/ Techniques used:
ChatGPT, Excel

MASS.

AUTODESK FOUNDATION

11 SUSTAINABLE CITIES AND COMMUNITIES

EarthEnable

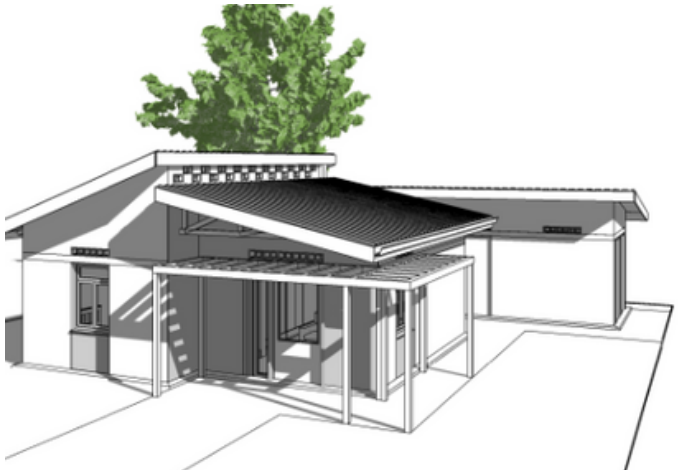
Optimizing & Visualizing the Construction of Rural Settlements

The objective of this project was to support EarthEnable in the design of rural settlements in Rwanda. The main aims were to improve adobe housing designs that currently exist in the EarthEnable catalog and to propose new adobe housing prototypes that are eco-friendly, optimize the use of land, accommodate facilities, and enhance individual safety and security.

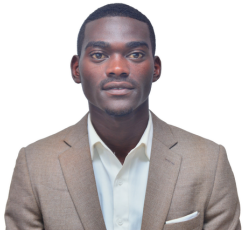
Software like AutoCAD, Revit, and 3Dsmax were used to help visualize and analyze construction implementation scenarios that make the best and most efficient use of limited resources.

Approximately 20 designs currently in EarthEnable's Revit catalog were reviewed, and opportunities for improvement were identified. In addition, the Fellow was involved in refining, redesigning, and adding to the existing catalog in AutoCAD & Revit from layout to detailing and building a detailed 3D model of earth block housing prototypes using Revit. Surveys were conducted to inform the final design and prototype before client-facing presentation materials, including hand-built models, were produced.

Outcome: Designs and physical models created for affordable rural household settlements.



Rural settlement designs and physical models
Attribution: Niyikiza Samuel



Fellow:
Niyikiza Samuel, Rwanda

Expert Fellow:
Radhika Mundra, India

Partner collaborators:

- Zena Marriam, Architectural Design Consultant, Rwanda

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
EarthEnable

Technology/ Techniques used:
Autodesk AutoCAD, 3ds Max, Revit

EARTH ENABLE

AUTODESK FOUNDATION

11 SUSTAINABLE CITIES AND COMMUNITIES

Coalfield Development

Fostering Sustainable Land Design & Revitalization

The aim of this project was to help Coalfield Development advance sustainable land design and revitalization while fostering workforce development. This was achieved through investigating rainwater harvesting and reuse solutions and associated planning, design, and implementation strategies for a space in West Virginia, USA.

Rendering of proposed shelter and water management module
Attribution: Joan Pearl Nalianya

This project considered permeable paving to mitigate the effects of stormwater runoff and advance placemaking strategies as a means to enhance the multi-functional nature of a site at West Edge.

The scope of the project included reviewing existing conditions and possibilities for green infrastructure geared toward water management and retention onsite at West Edge, understanding Coalfield workforce development capacities in construction, and conducting interviews with relevant internal and external partners.

Based on the research, a prototype and site plan was developed with permeable interlocking pavers, concrete grid pavers, and vegetation as the key surface treatments to manage stormwater flooding in the area. This intervention, coupled with the growing module, would provide tools for rainwater harvesting, growing, packing and gathering. The catchment surface that receives rainfall directly would comprise polycarbonate sheets to ensure unpolluted runoff. Rainfall would then be conveyed through PVC gutters and downpipes into plastic reservoirs.

Outcome: Sustainable design proposal for pavement and stormwater management.

Fellow:
Joan Pearl
Nalianya, Kenya

Expert Fellow:
Radhika Mundra, India

Partner collaborators:

- Nick Guertin, Senior Director - Revitalize Appalachia, USA

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Coalfield Development

Technology/ Techniques used:
Autodesk Revit, AutoCAD, Twinmotion

COALFIELD DEVELOPMENT

AUTODESK FOUNDATION

11 SUSTAINABLE CITIES AND COMMUNITIES

BamCore

Automating Component Placement to Increase Process Efficiency

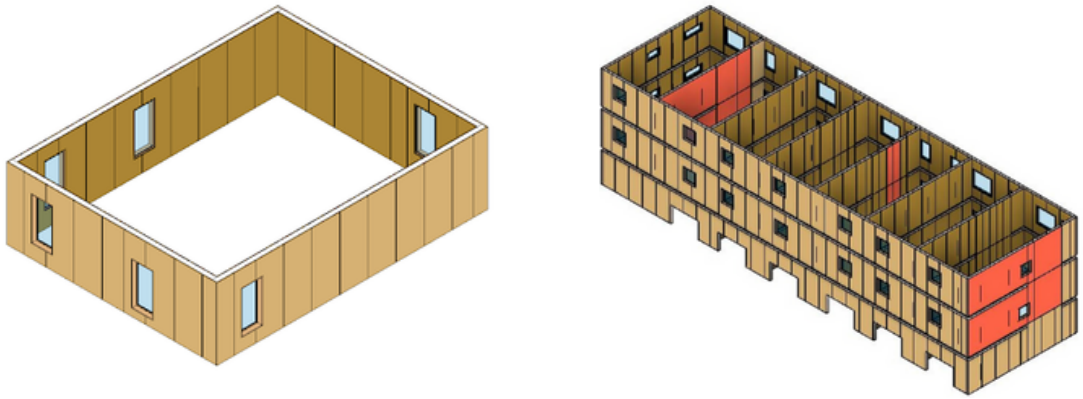
BamCore is addressing the pressing issue of the construction industry's significant carbon footprint, which accounts for nearly 40% of global greenhouse gas emissions. The organization's objective is to revolutionize construction with low-cost and carbon-negative solutions. To achieve this, BamCore has developed a three-stage process with sustainable materials encompassing material manufacturing, fabrication, and installation. This innovative approach promises faster, more efficient, and environmentally friendly construction, focusing on reducing construction time and labor requirements.

This project aimed to assist BamCore in accelerating construction and increasing efficiency by automating and streamlining its current processes.

The work focused on automating the panelization process, which is currently manual, by up to 80%.

By leveraging technologies, including Autodesk Revit, Python, and C#, a Revit plug-in was developed that automates BamCore's key tasks, including panelizing parts with and without openings, handling auto and manual header reveals, and auto-scheduling panels. This tool allows the team to automatically panelize 84% of parts in an average of 3 minutes, gaining 100x efficiency. Thus contributing to BamCore's goal of providing low-cost, carbon-negative construction solutions.

Outcome: Automation of the panelization process to save time in the design of low-cost, carbon-negative solutions.



Automating Panelization Process
Attribution: Symon Kipkemei

Fellow:
Symon Kipkemei, Kenya

Expert Fellow: Maël Sonna, Cameroon

Partner collaborators:

- Daniel Dias, Consulting Job Engineering, USA
- Hazem Kahla, Consulting Job Engineering, USA
- Theo Morrow, Director Job Design Analysis, USA

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
BamCore

Technology/ Techniques used:
Autodesk Revit API, C# and Python

BAMCORE

AUTODESK FOUNDATION

11 SUSTAINABLE CITIES AND COMMUNITIES

BamCore

Developing Product Roadmap for Digital Fabrication Platform

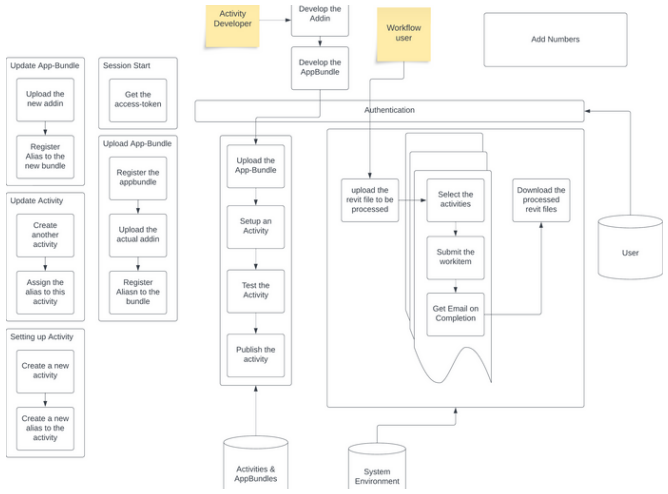
BamCore manufactures bamboo-based structural building components that are sustainable, carbon-negative, and speed up construction. Its unique process converts bamboo into engineered panels that can be used for framing buildings.

This project aimed to assess the potential integration and automation of BamCore's current processes, which involve many manual steps and different software tools. To achieve this, the Fellow investigated the use of Autodesk Platform Services (APS), a cloud-based platform that provides tools and services to connect workflows across different solutions, to automate and streamline processes. This would allow for a more scalable process that can take the organization's design models and convert them into fabrication-ready parts.

The Fellow explored the capabilities of APS and developed a roadmap to migrate BamCore's workflow to the platform. This involved understanding Bamcore's current processes, analyzing cycle times, and identifying key issues. The Fellow also analyzed the available options with APS, including Design Automation API, visualization options, and integration of BIM 360 and Autodesk Construction Cloud for end-to-end data management and internal enterprise resource planning solutions.

The project was divided into multiple phases, with the first phase focusing on the architecture diagram and the project breakdown. By implementing these strategies, Bamcore aims to revolutionize the construction industry and make housing more affordable while ensuring energy efficiency, saving time, and reducing labor needs.

Outcome: Product roadmap to save time in design of low-cost, carbon-negative solutions.



Architecture diagram
Attribution: Rutvik Solanki

Fellow:
Rutvik Solanki, India

Expert Fellow:
Deji Adebayo, Nigeria

Partner collaborators:
- **Daniel Dias**, Project Manager, USA

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
BamCore
Technology/ Techniques used:
Autodesk Forge, Notion

BAMCORE

AUTODESK FOUNDATION

VDI, ASME

Decarbonization Through Digitalization in the Transport and Habitat Sectors

This project aimed to explore potential fields for climate action in order to meet the 1.5-degree warming target identified in the Paris Agreement, investigating decarbonization through digitalization. The research focused on the habitat and transport sectors, which are two of the strongest contributors to global emissions, jointly accounting for approximately 34% of total global greenhouse gas emissions. Due to its high potential for emissions reductions, digitalization and the application of digital technologies are expected to be key drivers for sustainability and efficiency enhancements in these sectors.

Through in-person expert interviews and intensive desk research, this project identified and assessed the challenges, weaknesses, and potential of these technologies. It also proposed general recommendations for the partner institutions (ASME and VDI) and other organizations and companies to meet current climate challenges by enabling the implementation of digital technologies, energy efficiency increases, and education of young professionals.

Outcome: Report and recommendations for reducing environmental impact in transport and habitat sectors.

Solar panel and electric vehicle
Attribution: Pixabay

Fellow:
Rica Schulz, Germany

Fellow:
Alexander Eckervogt, Germany

Fellow:
Dalitso Kuntambila, USA

Fellow:
Pradyumna Rao, USA

Expert Fellow:
Martín del Pino, Argentina

This work was supported by:
VDI, ASME

Technology/ Techniques used:
Qualitative Research

Partner collaborators:

- Dr. Thomas Kiefer, International Affairs Coordinator - VDI, Germany
- Iana Aranda, Director, Engineering Global Development - ASME; President - E4C, USA

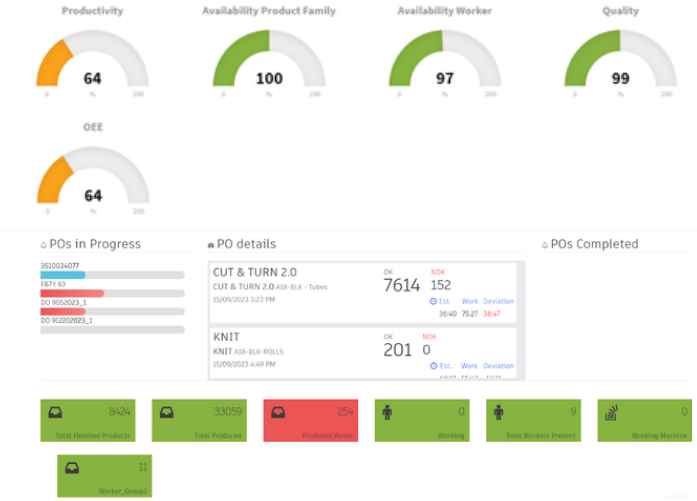
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Industrial Sewing and Innovation Center

Prodsmart Case Study for Apparel Manufacturing

ISAIC (Industrial Sewing and Innovation Center) is a national resource for those committed to positive impact through responsible production of high-quality garments and solutions centered around people, education, advanced manufacturing, and upward mobility for workers.

The apparel manufacturing industry has challenges in offering a standardized approach to workforce training. It requires timely worker skills updates as per technological enhancements. ISAIC is interested in implementing advanced techniques to improve manufacturing and reduce waste from the process by utilizing Autodesk Prodsmart software.



Prodsmart dashboard analytics
Attribution: Nishantkumar Trivedi

In this project, ISAIC aimed to measure all production records to improve the utilization of resources and increase the efficient use of natural resources for sustainable development.

This project aimed to build out ISAIC's production records and process workflows on Prodsmart. Research was conducted on inventory management and product development valuation, which includes raw material cost, labor cost, and equipment cost. The Fellow developed a customized analytics dashboard for individual product groups to measure specific data to take corrective actions and improve productivity and overall equipment efficiency. Additionally, maintenance requests, along with the recurring preventive maintenance schedule, were automated by analyzing the previous records. This improved machine availability.

Skills assessment and training requirement information was also developed in the software for stakeholders to stay up to date with technology changes in the industry. Therefore, production efficiency is set to improve by equipping employees with the required skill sets to operate specific machines.

Outcome: Build out of program to increase production efficiencies and workflows.

Fellow:
Nishantkumar Trivedi
Vadodara, India

Expert Fellow:
Joseph Kurebwa, Zimbabwe/UK

Partner collaborators:
- Lionel Vargas Cruz, Director of Operations, Detroit, USA

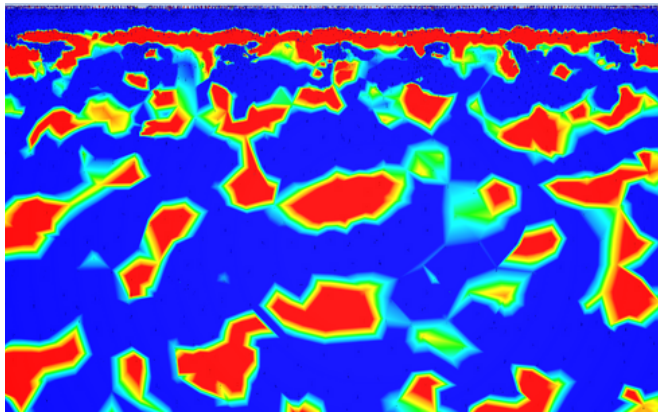
This work was supported by:
Autodesk Foundation
This work is in collaboration with:
ISAIC
Technology/ Techniques used:
Autodesk Prodsmart

ISAIC AUTODESK FOUNDATION

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Nth Cycle
Core Technology Fluid Flow Analysis

Nth Cycle sees an opportunity to draw the resources needed for the energy transition from electronic waste, scrap yards, and mining operations. The electro-extraction solution of Nth Cycle is an alternative to hydrometallurgy and pyrometallurgy and supports battery and electronics manufacturers, critical metal recyclers, miners and refiners. Rather than using large, greenhouse gas-emitting furnaces or harsh chemicals, the technology uses only electricity to transform the outputs of electronics recycling and waste from existing mines into high-quality, critical minerals ready for use again.



Fluid flow guidance plot for optimization of design
Attribution: Gabriela Gonzalez

The aim of this project was to establish a computational fluid dynamic model for the fluid flow within Nth Cycle's electro-extraction core technology that can be used to advise future designs and modifications to the cavity sizing and flow rates. This required an extensive review of prototypes and models of existing solutions to identify gaps and opportunities, conducting software surveys to understand tools available for the simulations, and creating clear CFD workflow – prioritizing important aspects and settings that need to be established to achieve feasible results.

The Autodesk Foundation supported the project by facilitating expert consulting, training, and tools for CFD simulation of fluid flow inside the system.

Outcome: Develop CFD models to advise future developments of electro-extraction core technology.

Fellow:
Gabriela Gonzalez Lopez, Mexico

Expert Fellow:
Jorge Bravo, Ecuador

Partner collaborators:

- Wyatt Roscoe, Director of Operations, USA
- Bill Caruso, Senior Mechanical Engineer, USA

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Nth Cycle

Technology/ Techniques used:
Autodesk Inventor, Autodesk CFD

NTH CYCLE AUTODESK FOUNDATION

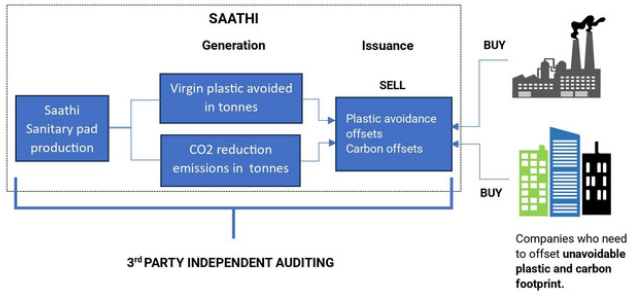
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Saathi

Plastic Avoidance Program for Compostable Sanitary Pads

Every year, about 400 million tons of plastic waste are generated, with only 15% being collected and 9% recycled, contributing to the current global plastic pollution crisis. Plastic pollution is on the rise and poses a serious threat to land and water habitats, accelerating environmental and climate degradation with detrimental effects on people's livelihoods, health, and quality of life. Thus, if the current patterns of production and consumption of plastics persist, plastic waste is projected to increase to 1,014 million tonnes in 2060. Therefore, the need arises for action in tackling the root cause of plastic pollution beyond the existing waste management strategies.

The objective of this project was to support Saathi in further developing its plastic avoidance program. Saathi is an organization that manufactures biodegradable and compostable sanitary pads from bamboo and banana fibers while empowering its community and safeguarding the environment. The plastic avoidance program is an offset program with an aim to create circular credits in the form of 'plastic avoidance credits' that address plastic pollution at source and carbon credits that offer added social and environmental benefits.



Short-term strategy to implement plastic avoidance program
Attribution: Chioma Adiele

The Fellow conducted research on the types of carbon and plastic credits, available credit markets, global standard framework options for certifying carbon and plastic offset programs, as well as identifying potential customers. The Fellow also worked on engaging key stakeholders in the certification process to determine the feasibility of the plastic avoidance program as well as the requirements for the step-by-step certification process from registration to issuance.

The key outputs achieved during the project were research on the carbon and plastic credit landscape, design of certification process flow for short-term and long-term implementation of the program, and a shortlist of potential partners.

Outcome: Report on plastic and carbon credits to support the reduction of plastic pollution.

Fellow:
Chioma Adiele, Nigeria

Expert Fellow:
Tanvir Khorajiya, India

Partner collaborators:
- Kristin Kagetsu, Co-Founder, India
- Tarun Bothra, Co-Founder, India

This work was supported by:
Engineering for Change
This work is in collaboration with:
Saathi
Technology/ Techniques used:
Qualitative Research

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

The Industrial Commons

Exploring Construction and Building Applications for Textile Waste

The building sector is increasingly prioritizing sustainability due to its high GHG emissions and waste generation. Seeking cost-effective and environmentally friendly materials for insulation is key for the sector to decarbonize while reducing waste.

Traditional insulation materials predominantly rely on non-renewable minerals or polymers, resulting in high embodied energy, significant global warming potential during production, and numerous challenges during disposal due to limited reusability and recycling options. In partnership with The Industrial Commons, this project aimed to investigate how textile waste can be used for building materials suitable to the organization's current waste stream and processes.

With extensive desk research on textile applications in the building materials industry and interviews with experts and key stakeholders, the project was able to propose new insulation materials with textile waste and the industrial process to develop them. This development allows a reduction in environmental impacts, an increase in productivity, and an expanded product offering, creating new markets and revenue streams.

Outcome: Report into textile waste applications in building materials to reduce environmental impacts.

Proposed supply chain for manufacturing of insulation material based on textile waste
Attribution: Arianna Andino & The Industrial Commons

Fellow:
Arianna Andino, Ecuador

Expert Fellow:
Martin del Pino, Argentina

Partner collaborators:

- Erin Kizer, Director - Land for the Commons, USA

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
The Industrial Commons
Technology/ Techniques used:
Qualitative Research

AUTODESK FOUNDATION

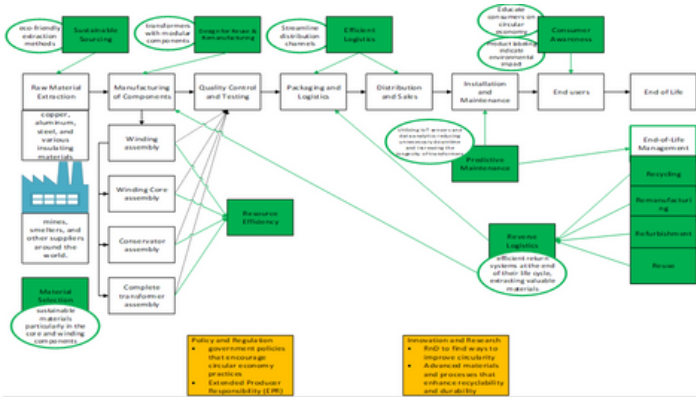
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Arizona State University

Supply Chains and Circular Economy of Power Sector

The transition towards a circular economy has gained attention worldwide as a means to achieve sustainable development goals and mitigate the environmental impacts of traditional linear production and consumption systems. This project aimed to further the transition by investigating the potential for a circular economy for transformers in Sub-Saharan Africa.

As part of this research, a life cycle analysis of transformers was conducted, assessing the carbon associated with each stage. The results suggest that there is a significant opportunity to reduce carbon emissions by adopting circular economy practices for transformers and can be targeted at specific components.



Proposed circular economy supply chain
Attribution: Mufaro Kanganga

It was found that materials used in an obsolete transformer can be injected back into the supply chain, which can be achieved by rethinking how transformers are disposed of. This would involve collaborating with suppliers, reducing reliance on virgin materials, and exploring refurbished products. Ethical and environmental benefits of using recycled materials and repairable products should also be considered.

External drivers for electric utilities to adopt circularity include reducing carbon emissions, increasing supply chain resilience, and addressing challenges of globalization and rapid urbanization. The benefits of circularity for businesses also include optimizing material use, accessing new revenue streams, and mitigating supply chain risks.

The project concluded by recommending a circular economic model for transformers in Sub-Saharan Africa, integrating the 4Rs: repair, refurbish, remanufacture, and recycle. A decision matrix was proposed to inform which path to take. The project also recommended a sustainable supply map for the transformer lifetime that integrates circular economy practices throughout the supply chain.

Outcome: Enhancing operational efficiency for increased supply chain agility and reduced environmental impacts of transformers in Sub-Saharan Africa.

Fellow:
Mufaro Kanganga, Zimbabwe

Expert Fellow:
Kithinji Muriungi, Kenya

Partner collaborators:

- Elena van Hove, Director of Global Energy Access, USA
- Nathan Johnson, Director of Laboratory for Energy And Power Solutions (LEAPS), USA

This work was supported by:
Arizona State University
This work is in collaboration with:
LEAPS, Arizona State University
Technology/ Techniques used:
Qualitative Research

Arizona State University

13 CLIMATE ACTION

Arizona State University

Just Energy Transition - No One Left Behind

In recent decades, we have experienced some of the extreme effects of climate change, like severe storms, prolonged droughts, rising sea levels, loss of biodiversity, increased health risks, poverty, and displacement. All of these pose a threat to humanity. The severity of these effects can be mitigated by changing our practices and putting people and communities at the centre of the solutions, thus the call for a Just Energy Transition. This concept goes beyond the phasing out of coal-fired plants and involves the assessment of the socio-economic, environmental, and geopolitical impacts that come with the transition.

Solar panel installation
Attribution: Creative Commons/USAID

This research aimed to provide an actionable framework for a transition that is based on work with communities and case studies to show the implementation of the process. The main objective was to ensure that, through the Just Energy Transition, a low-carbon economy is achieved in a fair and inclusive manner for everyone and provides opportunities for decent work while leaving no one behind. With particular consideration given to indigenous and vulnerable groups that are often not consulted in these developments.

This project involved desk research on existing transition case studies, identifying gaps while also identifying how "just transition" is defined and assessed for multiple frameworks. One of the important focus areas of the study was on the Pacific Island countries to identify major economic changes currently happening that would affect energy use and the energy mix. As a result, comprehensive data has been organized in spreadsheets about energy transitions and plans for 74 countries.

Outcomes: Research and data collected to advance the Just Energy Transition.

Fellow:
Elizabeth Obiero, Kenya

Expert Fellow:
Jorge Bravo, Ecuador

Partner collaborators:

- Nathan Johnson, Director - Laboratory for Energy and Power Solutions (LEAPS), USA
- Elena Van Hove, Director of Global Energy Access, USA

This work was supported by:
Arizona State University

This work is in collaboration with:
LEAPS, Arizona State University

Technology/ Techniques used:
Google Suite, Spreadsheets

Arizona State University

13 CLIMATE ACTION

Good Machine

Capturing High-Altitude Data for Natural Disaster Mitigation

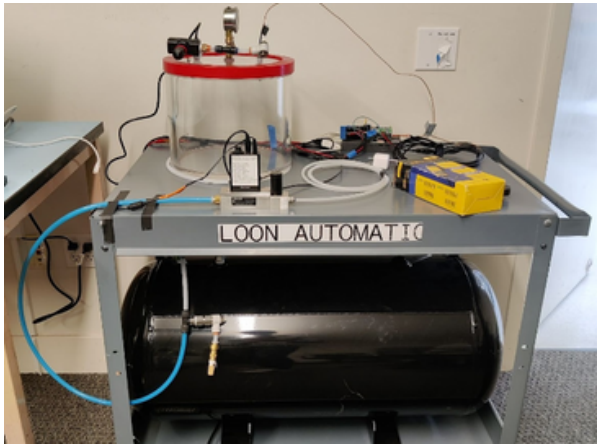
Good Machine venture studio's portfolio company utilizes a high-altitude platform to capture earth observation data, with a current focus on serving as an early warning system for wildfire detection. This project focused on the evaluation of high-pressure equipment's suitability for deployment as an in-flight balloon control system.

The primary challenge is in the equipment's capacity to operate under specific conditions, namely, handling low-pressure requirements while delivering output at significantly large rates. This was evaluated through testing to be beyond the capabilities of existing equipment in the market, including the one subject to examination.

Market research was conducted to explore available off-the-shelf alternatives. However, this inquiry revealed significant constraints, encompassing size, weight, power requisites, and, most critically, the capacity to effectively manage the required outlet for efficient transport during in-flight operations, all within strict time limitations. In light of these constraints, modifications to the design were deemed necessary to achieve technical feasibility, ensuring that the high-altitude platform could fulfill its control objectives.

Outcome: Testing of equipment to ensure quality and reliability of high-altitude platform technology.

Platform launch
Attribution: Pun Praphanphoj



Test bench
Attribution: Pun Praphanphoj

Fellow:
Pun Praphanphoj, Thailand

Expert Fellow: Kithinji Muriungi, Kenya

Partner collaborators:

- Kevin Roach, Chief Balloon Officer & Co-Founder, USA
- Beth Van Eman, Project Manager, USA
- Jen Cole, VP, Strategy & Impact, USA

This work was supported by:
Autodesk Foundation

This work is in collaboration with:
Good Machine

Technology / Techniques used:
Autodesk Inventor, Python, 3D Printing, Raspberry Pi, Autodesk Fusion 360

good machine

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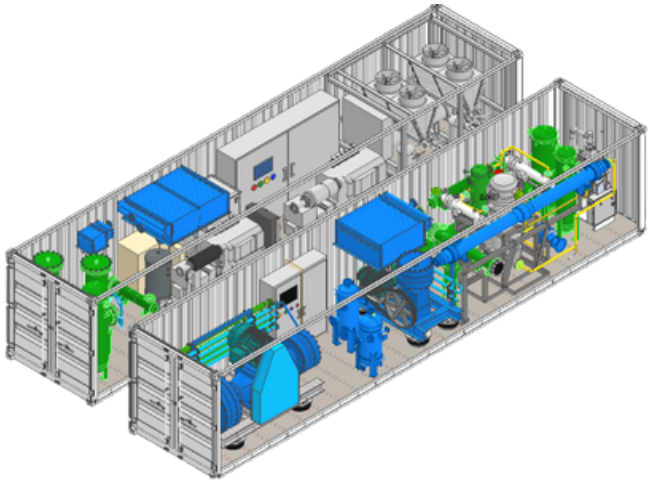
13 CLIMATE ACTION

M2X Energy

Refining Modules in Gas-to-Liquid Plant to Facilitate Containerization

When crude oil is extracted from underground and natural gas is brought to the surface, particularly in areas with limited infrastructure, this gas is burned off either at the top of a large stack or from a pit in the ground, often with devastating effects on local communities. In addition to the noise and light, flaring emits black carbon, methane, and volatile organic compounds, which are dangerous air pollutants. Natural gas flaring is both a waste of potential energy and a significant harm to the environment. It is estimated that the total natural gas flared every year globally amounts to around 140 billion cubic meters (IEA 2021). There are 16,000 gas-releasing flaring sites across the globe.



Containerized model of system
Attribution: Chinemerem Iheanacho

M2X aims to be the leading global supplier of small-scale modular, autonomous gas-to-product systems. M2X has developed a novel approach to green methanol production using what would otherwise be a waste stream: flare gas. The solution will mitigate significant volumes of GHG emissions by eliminating methane leakage through flare stoppages.

As part of this objective, this project supported in modeling the containerized M2X gas-to-liquid system to enable rapid global deployment to gas flaring sites around the world. The project involved optimizing CAD layouts, creating 3D models and photo-realistic renderings of mechanical equipment, piping and structure. This resulted in an improvement in the performance of the container solution, providing detailing for manufacturability and adaptability to the reduced space.

Outcome: Containerized model of gas-to-methanol system for easy deployment of the technology.

Fellow:
Chinemerem Iheanacho, Nigeria

Expert Fellow:
Jorge Bravo, Ecuador

Partner collaborators:

- Nicholas Schwartz, Principal Engineer, USA

This work was supported by:
Autodesk Foundation
This work is in collaboration with:
M2X Energy
Technology/ Techniques used:
Autodesk Inventor, Navisworks, Fusion 360

M2X AUTODESK FOUNDATION

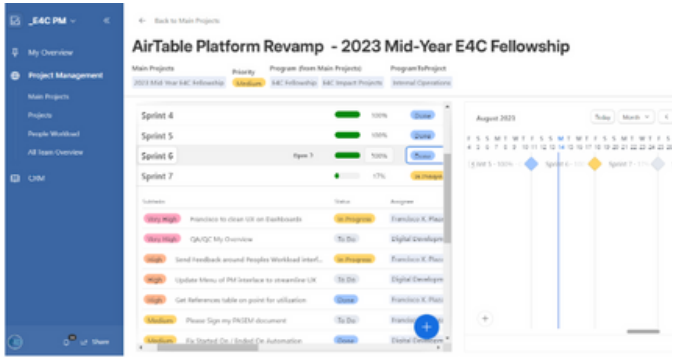
17 PARTNERSHIPS FOR THE GOALS

Engineering for Change

Internal Platform Development Through Airtable

Engineering for Change (E4C) is a global organization dedicated to preparing, educating, and activating the international technical workforce to improve the quality of life of people and the planet.

In order to grow the organization, a centralized tool is required for its external activities to manage interactions with current and potential sponsors, strategically approach opportunities, and streamline operations across its various programs like mentor sourcing and fellow recruitment. At the same time, E4C requires a centralized tool to manage all internal activities in a way that allows for time tracking, assigning responsibilities, building documentation, understanding resource allocation and activity tracking integrated into a daily workflow.



Revamped Airtable PM tool
Attribution: Joel del Castillo

The primary objectives of this project were to develop: a Customer Relationships Management (CRM) tool; a Program Management (PM) tool to improve communication across team members and leadership; and an external tool that allows collaboration with users outside the organization.

Research was conducted into shortcomings of the existing system and interviews were conducted with E4C staff and Fellows to understand the process of improvement. The Fellow conducted several design sprints and tackled development bottlenecks, resulting in a recommendation to work with Airtable and JavaScript to create the respective platforms.

The Fellow developed a database that synchronizes bases for data accuracy across the organization and developed web application interfaces that connect users to the databases without exposing the raw data. The Fellow also implemented Automation, a Cloud Function that relieves the burden on users of manually inputting a range of information. Clear documentation of the implementation was developed, including video tutorials, database schemas, and analysis documents.

Outcome: Improved CRM and PM tools to increase efficiency and allow E4C to scale operations.

Fellow:
Joel del Castillo, Ecuador

Expert Fellow:
Arya Sarkar, India

Partner collaborators:

- Francisco Plaza, Jr. Program Specialist, Ecuador

This work was supported by and in collaboration with:
Engineering for Change

Technology/ Techniques used:
Airtable, JavaScript

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