

# Service Design for Modern Energy Cooking Services

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The Modern Energy Cooking Services (MECS) programme is a £40 million (\$50.5 million) UK Aid supported initiative aimed at promoting modern energy cooking services in the Global South. The programme works through a multi-partner program of activities, led by Loughborough University in the UK, to catalyse the transformation of the clean cooking and electrification sectors that can enable widespread uptake of modern energy cooking services. This could generate inclusive environmental and development benefits for the poor by enabling technological, institutional, and market innovations. One of the key MECS programme approaches is to leverage the enormous progress that has been made globally on access to electricity to drive forward the clean cooking sector. Electric cooking (eCooking) has long been considered 'inappropriate' for use in development programs. However, the landscape of electricity access has changed, with many more people now connected to both grid and off-grid electricity and the quality of supply becoming increasingly more reliable. What is more, an array of new energy-efficient electric cooking appliances is now available, opening a myriad of new opportunities for access to cost-effective and convenient modern energy cooking services.

This data and material have been funded by UK AID from the UK government; however, the views expressed do not necessarily reflect the UK government's official policies. An updated and more usable version of this working paper is planned for publication in the year 2022. Please contact Dr. Marianna Couletianos for further information.

## Executive summary

Service Design for Modern Energy Cooking Services (SD4MECS) was a 1-year project (March 2021 - February 2022) that has iteratively developed a framework for a MECS Living Lab (LL) with the MECS CREST field trial used as a 'live test site' to develop the MECS LL framework. The LL framework is intended to further application of Human-Centred Design (HCD) within future MECS field trials. The CREST trial is investigating battery-supported e-cooking with Power Stations designed by the CREST team (Loughborough University) with Country Partners (CPs) SCODE (Kenya), TaTEDO (Tanzania), and CREEC (Uganda) for distribution to 120 households.

The SD4MECS project aimed to apply a Human-Centred Design (HCD) approach to generate understanding of the needs and aspirations of everyday cooks and empower them as co-creators of innovative modern energy

cooking services, thereby enhancing the development of more culturally informed and more desirable modern energy cooking services. Due to the timeline of the CREST field trial (which is still ongoing, with the first round of LL due to wrap up in May 2022), this report focusses on the methodological approaches used to set up the LL. Three main HCD methods implemented in the CREST field trial are portrayed in Figure 1: Interviews (intake, mid-point, exit); Mobile Research (biweekly engagement with participants via WhatsApp), and Workshops (three full-day workshops).

The LL approach was grounded in the literature on LL theory and practice, in Service Design (SD), and in HCD. Therefore, the SD4MECS team first established a LL manifesto to frame the approach and evaluated the whole trial against the manifesto, including re-evaluating the research questions (RQs) and adding SD4MECS specific RQs; re-evaluating the ethical implications of the trial; and creating a holistic journey map of the participants' experience of the trial, thereby consolidating the timeline and sequence of all study activities.

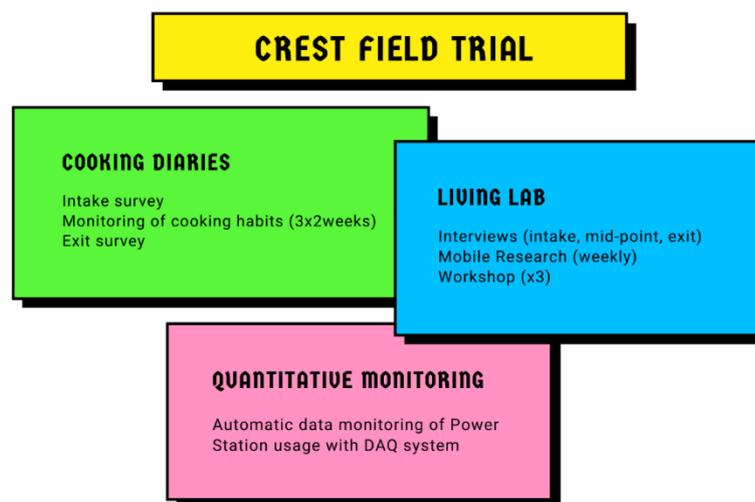


Figure 1: 3 main data collection approaches to the CREST trial

SD4MECS major outputs are the following:

Output 1: Survey of the Literature & HCD actors in the Global South – a review of the literature and HCD practice in Africa. The SD4MECS team surveyed the literature and the current actors at the intersection of energy, cooking, and HCD and /or Global South and HCD.

Output 2: Living Lab toolkit and Output 3: Journey Mapping toolkit – the SD4MECS team contributed to building of a menu of design-driven methods for future MECS research, based on the state of the art conducted, by creating Journey Mapping and LL toolkits to make accessible both methods/approaches/frameworks to researchers without design research or qualitative research backgrounds working on MECS topics. Both toolkits were informed by the literature survey and by the SD4MECS lead researcher's experience of directly contributing to the CREST field trial.

Output 4: CREST Living Lab Documents and Materials – SD4MECS extended team which included link researchers and CPs, created and implemented a tailored LL for the CREST field trial. All documents pertaining to the LL for the CREST field trial are provided in the associated document [CREST Living Lab Documents and Materials](#).

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## Acronyms

CP	Country Partner	LMIC	Low- and Middle-Income Countries
CREST	Centre for Renewable Energy Systems Technology	MECS	Modern Energy Cooking Services
DfD	Design for Development	RA	Research Associate
e-cooking	Electricity-based cooking	RQ	Research Question
HCD	Human Centred Design	SD4MECS	Service Design for Modern Energy Cooking Services
LL	Living Lab		
IRB	Institutional Review Board	SD	Service Design

## Introduction

### Team

SD4MECS core team: School of Design and Creative Arts, Loughborough University, UK.



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## Project Goals and Objectives

SD4MECS was a 1-year project that ran from March 2021 to February 2022, during which a full time Research Associate (Dr. Marianna Coulestantos) led the research, supported by two co-investigators in the School of Design and Creative Arts (SDCA) (Dr. Stuart Cockbill and Dr. Val Mitchell). SD4MECS iteratively developed a framework for a MECS Living Lab (LL) with the MECS CREST field trial used as a 'live test site' to develop the MECS LL framework. The LL framework is intended to further application of HCD within future MECS field trials. The MECS CREST field trial is investigating (as of 2022) e-cooking with Power Stations designed by the CREST team (Loughborough University) with Country Partners (CP) SCODE (Kenya), TaTEDO (Tanzania), and CREEC (Uganda) for distribution to 120 households in a six-month trial.

SD4MECS aimed to apply a Human-Centred Design (HCD) approach to generate understanding of the needs and aspirations of everyday cooks and empower them as co-creators of innovative modern energy cooking services. HCD is a broad term used to describe a range of existing design and innovation approaches that take a systemic and iterative approach to understanding user and stakeholder needs. By gaining a better understanding of the needs and aspirations of everyday cooks and positioning them as co-creators alongside other key stakeholders in MECS field trials, SD4MECS aimed to enrich the development of more culturally informed and more desirable modern energy cooking services, thus facilitating adoption of MECS in the Global South. Due to the timeline of the CREST field trial (which is still ongoing, with a the first round of LL due to wrap up in May 2022), this report focusses on the methodological approaches used to set up the LL. The SD4MECS team will continue to support the implementation of the LL and analysis of the data that is produced.

SD4MECS focused on two specific HCD techniques: LLs and Service Design. LLs facilitate HCD and innovation by providing a methodological framework for involving end users in the process of design by enabling them to evaluate products and services in their context of use over time. Service Design (SD) facilitates the development of services to make them more useful, usable and desirable for users, but also more efficient and effective for organisations. It supports not only the design of the end user service experience, but also the organisational structures and resources needed to deliver it. The SD4MECS project particularly leveraged the SD method of user journey mapping.

The CREST field trial aimed to test, in real-use conditions, the AC and DC Power Stations technology which consisted, in the case of the AC system, of a battery system meant to stabilize unstable grid connections for households already connected to the grid, and for the DC system, of a {battery + solar panels} system, both meant to provide enough continuous electrical power to support electricity-based cooking.

The CREST trial, as designed without the LL component, originally planned on studying participating households during a baseline phase, then distribute the Power Stations and e-cooking appliances to households and study their use of the technologies over a period of 3 to 11 months. The data collection planned included cooking diaries (intake and exit surveys, multiple periods of daily reporting of all food and water prepared) and quantitative monitoring (automated data monitoring of the usage of the Power Stations through the DAQ system). The RQs that framed the trial are provided in the associated document [\*CREST Living Lab Documents and Materials\*](#), there were more than 20 RQs asked by more than 15 researchers in 10 different departments and institutions. The LL approach was added as a complementary approach to the cooking diaries and quantitative monitoring of the Power Stations. The main HCD methods implemented in the CREST field trial are portrayed in Figure 2, where the LL approach consisted of 3 main methods: Interviews (intake, mid-point, exit); Mobile Research (biweekly engagement with participants via WhatsApp), and Workshops (three day-long workshops).

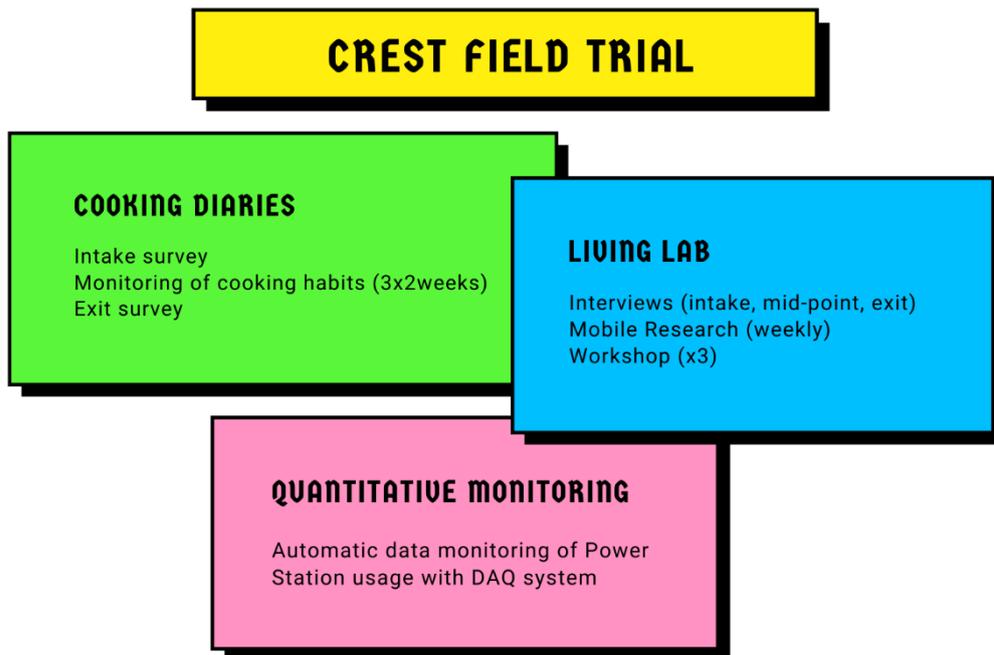


Figure 2: Three main data collection approaches to the CREST trial

The LL approach was grounded in the literature on LL theory and practice, in SD, and in HCD. Therefore, the SD4MECS team first established a LL manifesto to frame the approach and evaluated the whole trial against the manifesto, including re-evaluating the RQ and adding SD4MECS specific RQs; re-evaluating ethical implications of the trial; and creating a holistic journey map of the participants' experience thereby consolidating the timeline and sequence of all study activities.

## Deliverables

SD4MECS major outputs are the following (Figure 3):

Output 1: Survey of the Literature & HCD actors in the Global South – a review of the literature and HCD practice in Africa. The SD4MECS team surveyed the literature and the current actors at the intersection of energy, cooking, and HCD and /or Global South and HCD.

Output 2: Living Lab toolkit and Output 3: Journey Mapping toolkit – the SD4MECS team contributed to building of a menu of design-driven methods for future MECS research, based on the state of the art conducted, by creating Journey Mapping and LL toolkits to make accessible both methods/approaches/frameworks to researchers without design research or qualitative research backgrounds working on MECS topics. Both toolkits were informed by the literature survey and by the SD4MECS lead researcher's experience of directly contributing to the CREST field trial.

Output 4: CREST Living Lab Documents and Materials – SD4MECS extended team which included link researchers and CPs, created and implemented a tailored LL for the CREST field trial. All documents pertaining to the LL for the CREST field trial are provided in the associated document *CREST Living Lab Documents and Materials*.

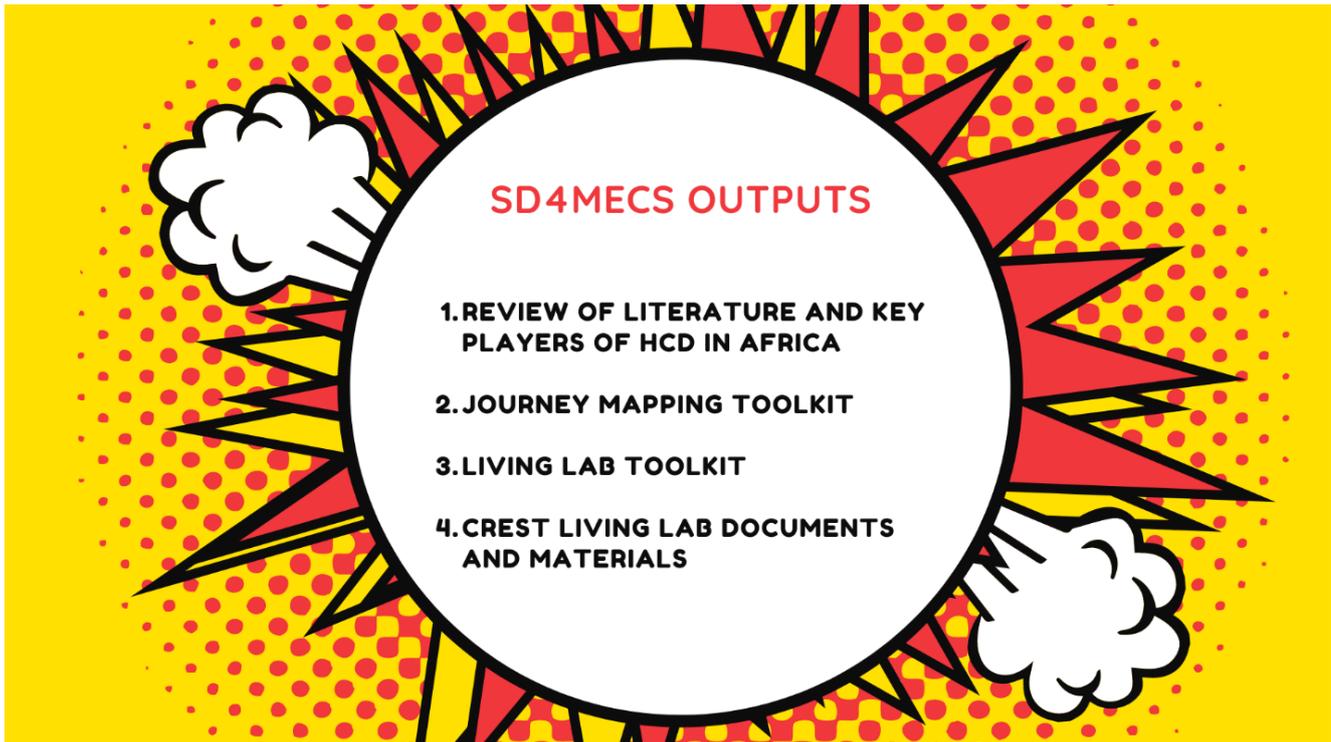


Figure 3: SD4MECS deliverables

## Positionality statement

As the SD4MECS team, we reflected and considered how our identities as people, designers, researchers would influence this project. We are a group of white people designing a trial experience for Kenyans and Tanzanians and the core SD4MECS team are living in the UK without the opportunity to travel to these contexts due to COVID-19 and FCDO funding cuts. The core School of Design and Creative Arts team started off knowing little to nothing about the life experiences of trial participants and have therefore worked to involve CPs and colleagues with experience in Kenya and Tanzania (Jon and Anna) in the creation of SD4MECS tools. We recognize the power imbalance that comes from the Global North – Global South divide and from our identities as researchers and as Westerners, and we recognize the increased challenges of working cross-culturally amid COVID-19, which made travelling and in-person fieldwork impossible for the SD4MECS team.

As such, we framed SD4MECS with guiding frameworks that acknowledged our Western identities (Sidekick Manifesto, [1]) and our grounding design approach: human centred co-design [2]. Frameworks for the work are introduced in the *Guiding frameworks* section. Furthermore, we adopted a stance that technical solutions are not always the best and questioned the assumption that “modern energy” is beneficial, as discussed in the paper by Bharadwaj et. al. about the co-benefits of cooking with firewood [3].

We also acknowledge that this report is being written amid the 2+ year ongoing global pandemic of COVID-19, and amid increasing reckoning of global sexism, racism, and imperialism. This context has and continues to impact this work and the SD4MECS team.

## The value of HCD in MECS

HCD is a broad term used to describe a range of existing design and innovation approaches that take a systemic and iterative approach to understanding user and stakeholder needs. This approach ensures that products and services are useful, usable, and desirable at the point of use. iDE Cambodia’s (2020) MECS-TRIID project has successfully demonstrated the value of taking a HCD approach in a MECS context, and how it can help to position cooking with modern energy as an aspirational service for everyday cooks in the Global South.

Low- and Middle-Income Countries (LMICs) face additional constraints compared to high-income settings [105]. Obstacles preventing significant impact of new products and services in low-resource settings are threefold: the non-existence of the technology (technology does not exist that is suitable for use in LMICs), the hindered access due to price, energy, and human resources inadequacy, and technology which is not culturally acceptable [3]. Some examples of reasons for product failings in LMICs include that the product does not solve the problem it intended to; it is too complex and introduces more problems [110]; low-profit margins; regulatory constraints; and incompatibility with the systems in place [111]. Kroll et al., 2013, argue that part of these problems could be solved if engineers had a better understanding of the underlying needs of the people for which they are trying to design [95].

The SD4MECS project focused on developing HCD best practice by adapting, applying, and developing a framework for scaling HCD methods within the MECS programme in places where detailed understanding of the experiences of cooking with modern energy are required. It enabled Southern Partners and MECS research teams to draw upon aspects of HCD best practice when seeking to develop, trial, and roll out new modern energy cooking services. By drawing upon existing methods and key stakeholders within the programme, SD4MECS aimed to understand how HCD can be applied effectively in this context and how it can be adapted and scaled to other MECS contexts to uncover the desired experiences of everyday cooks in other cultures and situations.

**Unfortunately, due to the timeline of the CREST field trial, to this date, little data has been collected through the LL implemented by the SD4MECS team and therefore no significant data analysis has been completed. Therefore, this report is focused on the methodological learnings from implementing a LL in the CREST field trial and we hope that subsequent outputs, including publications, will focus on the analysis of the qualitative data collected.**

SD4MECS primarily fitted within MECS Workstream 2.3 - Behavioural Change. The objective of this workstream was to understand the needs and aspirations of everyday cooks and assess their compatibility with different modern energy cooking services. The workstream is designed to produce a set of consumer preference studies that can inform other parts of the programme regarding the needs and aspirations of everyday cooks in specific Global South contexts.

# Methodology

## Guiding frameworks

The SD4MECS team selected three guiding frameworks to frame the use of HCD and SD in MECS. The new MECS narrative [4] (Figure 4) contextualized SD4MECS work among the larger goals of the MECS programme. [The Sidekick Manifesto](#) [1] (Figure 5) consists of a manifesto, an open pledge, and several resources for people working in international development. SD4MECS pledged to place the voices, needs, wants, and wellbeing of the people we are designing for and the study participants, above all else. [The IAP2 Spectrum of Public Participation](#) [5] (Figure 6) guided the team's efforts to move from a top-down model of research to a true participatory model.

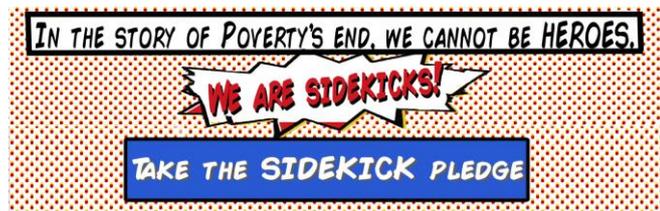


Figure 5: Excerpt from the Sidekick Manifesto [1]

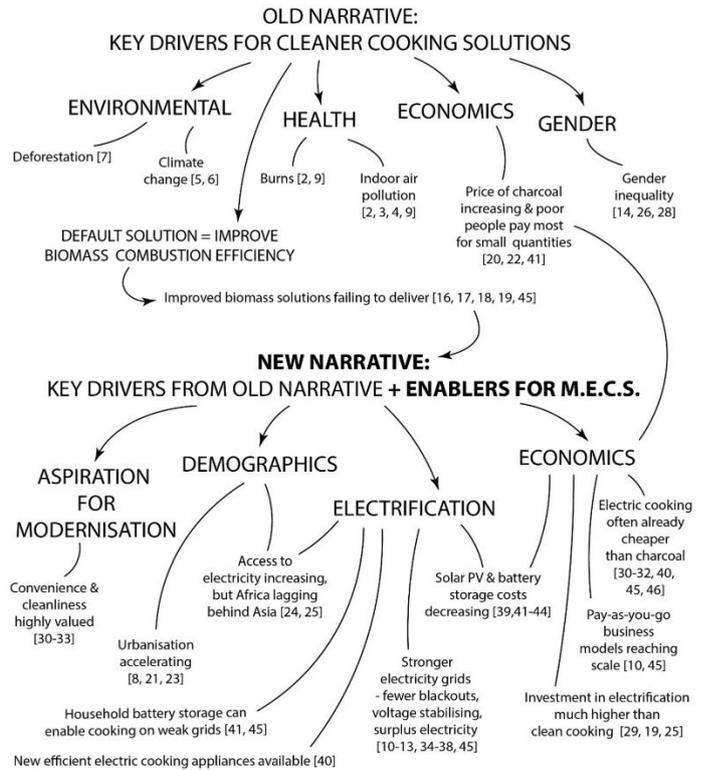


Figure 4: Graphical overview of the New Narrative Argument [4]

## IAP2 Spectrum of Public Participation



IAP2's Spectrum of Public Participation was designed to assist with the selection of the level of participation that defines the public's role in any public participation process. The Spectrum is used internationally, and it is found in public participation plans around the world.

		INCREASING IMPACT ON THE DECISION				
		INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL		To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
	PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Figure 6: IAP2 Spectrum of Public Participation [5]

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## Key Activities

Table 1: Key SD4MECS activities between March 2021 and February 2022. Grey highlights point to activities that were taken on by the SD4MECS team despite those activities being initially out of scope for SD4MECS.

Contribution level	Activities
SD4MECS Leadership	<ul style="list-style-type: none"> <li>Unified and submitted the Institutional Review Board (IRB) application at Loughborough University and supported CPs in obtaining local approval.</li> <li>Identification of suitable methods to support the generation of salient data around adoption and use of modern energy cooking.</li> <li>Conducted a literature survey on relevant topics; explored existing HCD methodologies and their use in the African context, and met with 4 actors in the space: Heloise Pichot from Burn Manufacturing, Amey Bansod from iDE Cambodia, Mamso Ukpanah from Koumkuey design, and Fiona Lambe from SEI.</li> <li>Trained CPs (SCODE and TaTEDO) in LL methods (journey mapping, workshop, interviews, mobile research) by conducting training sessions via Teams and by conducting mock journey mapping sessions, workshops, interviews, and mobile research with the teams.</li> <li>Developed all LL materials compiled in the document <u>CREST Living Lab Documents and Materials</u>.</li> <li>Developed the <u>MECS Journey Mapping Toolkit</u>.</li> <li>Developed the <u>MECS Living Lab Toolkit</u>.</li> <li>Analysed the 40 transcripts of the first interviews conducted with urban participants in Kenya and Tanzania, and created a journey map for each participant.</li> <li>Linked with enumerators and CPs via WhatsApp for continuous discussion on the trial activities and LL method (e.g., feedback gathered from enumerators after each interview and a re-training resource was created integrating feedback; biweekly engagement with enumerators about the mobile research).</li> <li>Led a reflection activity with main LL stakeholders.</li> </ul>
Heavy contribution	<ul style="list-style-type: none"> <li>Unified all study RQs and study activities into a coherent sequence.</li> <li>Co-lead relationship with SCODE regarding the CREST trial, including check-ins via WhatsApp and regular Teams calls.</li> <li>Participated in regular leadership meetings during which crucial decisions about the study were made when obstacles emerged. Offered a participant-centric perspective to study hurdles.</li> <li>Helped to develop the WhatsApp Bot for cooking diaries. Provided HCD input into cooking diaries by encouraging reflection on data entry from the point of view of everyday cooks.</li> </ul>
Light contribution	<ul style="list-style-type: none"> <li>Contributed regular updates about the CREST trial to the larger MECS program.</li> <li>Met with other MECS researchers outside of the CREST pilot to advise and share resources on HCD tools, methods, and approaches. Such researchers include Dr. Long Seng To, Dr. Nick Rousseau, and Steyn Hoogakker.</li> <li>Contributed to the unification of the documentation shared by Loughborough and Gamos researchers to CPs.</li> </ul>

## Major hurdles

Table 2: Summary of major study hurdles

Hurdle	Impact on the study
Delays in getting the Power Stations in country	While the Power Stations were supposed to arrive in country before SD4MECS started, Power Stations were received and unboxed over the 2021 Summer and participant recruitment started in September 2021.
Improper DC electric appliances	Due to the DC electric appliances being unsuitable for use by study participants, the leadership team sought out a DC EPC that would be made to order in China. The situation with the DC electric appliances contributed to the delays. As this report is being written, the state of the DC EPCs is still undetermined. Currently, it is unclear if and when the DC rollout will happen for rural participants.
Budget cuts and study-rescoping	The MECS programme suffered budget cuts. While the CREST trials survived the cuts, all non-essential spending was removed. CPs revised their budgets and had to significantly reduce the scope of the study (time and number of participants). This also eliminated any travel budget that could have enabled the SD4MECS RA to work alongside the CPs in Kenya and Tanzania.
COVID-19 travel restrictions	University travel restrictions and budget cuts prevented the SD4MECS RA, Dr. Marianna Couliantanos, to travel to the study countries to have more direct contact with CP, enumerators, and study participants. Training of CPs was therefore mostly conducted remotely rather than in person (with occasional travel to the field sites by the country link researchers), which has been extremely detrimental to transfer of knowledge. The LL approach was implemented with no on-the-ground coordinator from the SD4MECS core team, so feedback loops were on the scale of weeks rather than days, which was detrimental to the implementation of the approach as it prevented fast iteration of the methods based on participant and enumerator feedback.

The major overall impacts on the study were the following: all LL training and activities carried out and observed remotely by SD4MECS team, no opportunity to follow a full rollout of a LL, no opportunity to iterate the LL, little to no opportunity to analyse data from the LL. Initially, SD4MECS planned to implement several different rollouts of the LL activities, which would have enabled iteration and experimentation with different LL tools and approaches. The delays meant that within the year long SD4MECS project, we were not able to observe even a single rollout from start to finish (this report is being written during the middle of the urban rollouts in Kenya and Tanzania).

The one benefit of this unfortunate situation is that as all of the training was delivered remotely, the set of resources developed are now much more comprehensive and could facilitate the set up and operation of other MECS LLs remotely.

## Key results and findings

### Manifesto

**What?** Based on the guiding frameworks and the objectives of the CREST trial, SD4MECS developed a manifesto for the LL implemented in the CREST trial (Figure 7). This manifesto was the guide for developing the tools for the CREST LL and served as a guide for all SD4MECS work pertaining to the CREST LL.

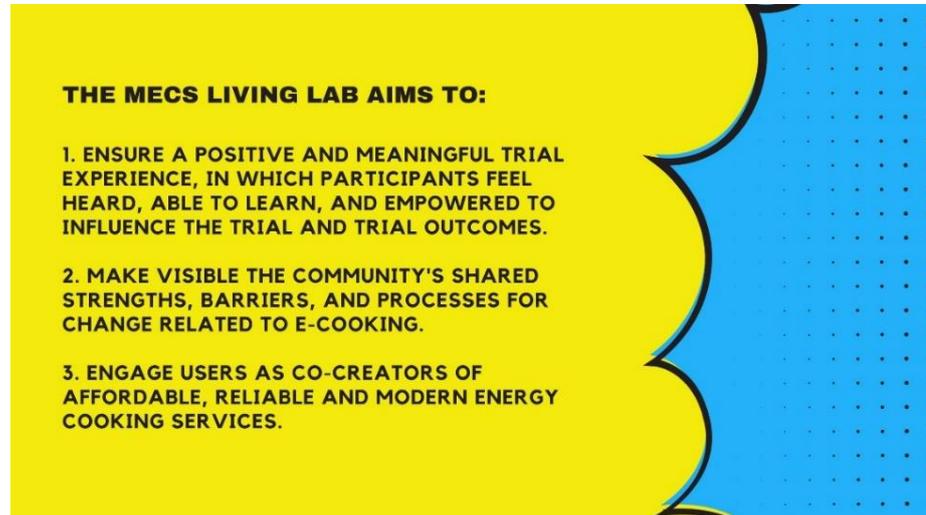


Figure 7: CREST LL Manifesto

**So what?** An example use of the manifesto: SD4MECS mapped the study activities back to the manifesto to make tangible the levers available to the research team to achieve the goals set out in the manifesto (Figure 8).



Figure 8: Mapping the study activities to the Manifesto objectives. The three sentences of the Manifesto were broken down into the individual objectives and the study activities were mapped to the respective objectives they would help achieve. For example, interviews were considered a key moment during which participants could feel heard.

**Now what?** The manifesto will continue to serve as a guide as the trial unfolds and as data analysis progresses. We propose that this manifesto also reflects the goals and the value of an HCD approach in MECS.

## Output 1.1: Survey of the Literature

This section synthesises the SD4MECS survey of the literature and situates the SD4MECS work within current research in modern energy cooking.

### **There is a need for more HCD in clean cooking and electricity access research.**

There is a widespread understanding that many failures in the clean cooking and electricity access sectors have stemmed from the lack of understanding of people's needs and from a detracting focus on technical aspects such as efficiency and emissions reduction [6]. Researchers in the clean cooking spaces have reached the consensus that there is a need for more HCD in clean cooking research [7–9]. Some similar evidence has emerged in the electricity access space [10,11]. Hence, many studies in the clean cooking and electricity access sectors now include the gathering of qualitative data using methods such as usability testing [6], interviews [12], SD and journey mapping with participatory activities [13]. The strengths of past studies include mapping barriers and enablers of clean cooking transitions, and increasing the participation of various stakeholders in the decision making around clean cooking transition, for example by influencing technology design [6] or by creating guidelines for more supportive environment for behaviour change [12]. The MECS programme has itself started using HCD methods, notably in the work carried out by iDE Cambodia [14].

### **HCD applied by Westerners in LMICs is not straightforward.**

Many of the research approaches and methodologies used in High Income Countries (HICs) are challenging to adapt for LMICs [15]. Dupas et al. (2014) [16] argues that because of the difficulty in implementing large scale quantitative methods that have been in use within market research in HICs for decades, in LMICs it is harder to uncover the latent needs of communities. Hence, the primary way designers and engineers have been collecting needs is through qualitative methods including focus groups and interviews, and sometimes small-scale surveys, which have been inadequate for fully capturing LMIC stakeholder needs and desires. It is necessary, therefore, to identify methods that are appropriate for LMICs, and to engage stakeholders in the 'discovery' stage of the HCD design process, where underlying needs are uncovered.

Furthermore, when Westerners design in LMICs, cultural differences between designers and stakeholders can create difficulties in the implementation of early design activities [17–19]. Frequently in such scenarios, cross-cultural design occurs remotely, which creates additional barriers to stakeholder engagement. Barriers include language (native and/or disciplinary); different conventions around design processes and methods [15]; perceived hierarchy between designers and stakeholders [20]; and cognitive biases that influence designers' processes [21]. These barriers can lead to miscommunications between designers and stakeholders, especially during early design phases [22], further supporting the need to develop appropriate methods to support design activities within these settings.

An increasing number of design methods geared towards design for LMICs have been developed in recent years. These methods are mainly underpinned by a business mindset following the movement for "business for the base of the pyramid," or a technology mindset, where designers are developing technology specifically to address the needs and constraints of LMICs [23]. The literature review, however did uncover some examples of HCD approaches developed for use in low-resource settings. Some aim specifically to address the challenges of cross-cultural design [24], notably through design ethnography [25]. Aranda Jan, Jagtap, and Moultrie, 2016, highlight the lack of tools to support contextual design in low-resource settings, and developed a framework to support designers in considering contextual factors in design for low-resource settings [26]. Other related approaches include the design for scarcity, design for scalability, design of simple solutions [27], design of appropriate training [28], and design for access, through affordability, availability, and adoption [29].

Furthermore, because traditional methods of stakeholder engagement fail to elicit useful information in some cross-cultural design settings, practitioners have developed methods specifically to tackle cultural differences [30]. Such methods include cultural probes [31], the Bollywood technique that consists of asking stakeholders to imagine they are in a television drama to encourage them to break with cultural traditions of “maintaining harmony” and “deferring to the group” [24,30], the Walking Havana method consisting of creating personas with the help of stakeholders by asking them to create protagonists of a television show that would take place in their local setting [32], as well as other recommended practices such as hiring local facilitators [30].

Among this array of potential design strategies for LMICs, there is a consensus on the benefits of increased stakeholder involvement for the successful design and implementation of appropriate devices [28]. The involvement of stakeholders, often members of the community one is designing for, is a key tenant of Design for Development (DfD) [17,33,34]. The inclusion of contextual considerations such as socio-economic, political, cultural, historical, and environmental aspects are emphasized in DfD methods [18]. The simple consideration of stakeholder needs is not sufficient in DfD, and various sources suggest including stakeholders in a design process through participatory activities [17,33,35]. Caldwell et al. 2011 recommended rapid prototyping and extensive field-testing when designing for low-resource settings [28]. Extensive co-creation, where stakeholders are involved in each step of a design process, is now being widely encouraged for the design and development of medical devices for use in LMICs [28]. Strong local relationships with stakeholders [36] are also a crucial part of successful design for LMICs, along with user empowerment [37] and local ownership [38].

However, there is little practical guidance as to how to carry out design activities in these settings. The previously mentioned literature mostly suggests very general solutions, and little work has investigated specific design methodologies that are effective for designing devices for LMICs [26]. The absence of detailed investigation into stakeholder engagement methods in the field of DfD was proposed as a reason for why even experienced practitioners did not describe in-depth collaboration with stakeholders during an exercise working through a hypothetical scenario [34]. Although experienced designers were aware of the importance of involving various stakeholders in an DfD design process, they still were not able to articulate how they would involve them in a process [34].

### Example of prior HCD work in MECS

The **MECS-TRIID project led by iDE Cambodia** is the most salient example of HCD used in the MECS program prior to the SD4MECS project [14]. Methods used included in-depth interview, card sorting, observations and rapid interviews (in markets, fuel distribution shops, gas stations, retailer shops), and immersion in home-stays. Research participants included *early adopters & late majority profiles and the goal was to understand their needs, constraints, and barriers to adoption*. Participants also included representatives of *Retailers, Fuel suppliers, Electrical Shops, Restaurants, and Food Vendors*. Outputs from the MECS-TRIID project included User adoption journey maps and personas, a list of factors enabling MECS adoption, and a co-creation workshop proposing solutions corresponding to the identified factors.

Factors enabling adoption included: increased exposure to MECS, marketplaces stocking new cooking solutions, migrant family members, new last mile distributors, social proofing, aspirational cooking, ease and convenience, changes in housing, fear of Liquid Petroleum Gas (LPG), increase in purchasing power, taste of meals, and reliability over time. Barriers affecting adoption included: low knowledge and awareness, challenges accessing products and marketplaces, challenges in reaching last mile customers, mistrust of finance plans, low financial prioritization for cooking, fear and safety concerns surrounding LPG, fragmented value chains, established perceptions of electricity, and gender norms in decision making and access to MECS.

A notable step in the analysis conducted by the iDE Cambodia team was to translate the factors and barriers into design principles, namely: accessibility, affordability, reliability, quality, efficiency; ease and convenience;

inclusive and equitable for people who cook; benefit oriented; avoid cultural barriers; preserve taste and tradition. These served as the basis for the co-creation workshop conducted with designers, researchers, engineers, and subject matter experts. While end-users were not involved in the workshop, the outputs of the workshop led to ongoing follow-up studies to conduct testing of workshop ideas with users.

### Role of SD4MECS

The LL framework developed by SD4MECS, which includes stakeholder engagement, co-creation, and real-life environment continuous testing, has great potential as a method for design in LMICs. The work of SD4MECS aims to make more accessible the LL methods for the MECS programme by providing detailed guidance as to how to apply such methods in the context of MECS, with direct experience from applying these methods in two East African countries. LL and, more generally, HCD methods appropriate for use in specific LMIC contexts may contribute towards “levelling the playing field” between Western designers and in-country stakeholders.

### What are Living Labs?

The review of LL literature by Hossain et. al. (2019) [39] was used as the basis for creating the LL framework in the LL toolkit developed by SD4MECS. “A living lab is a physical or virtual space in which to solve societal challenges [...] by bringing together various stakeholders for collaboration and collective ideation.” [39] There are three paradigms of a LL, meaning that these three aspects are what distinguish a LL from other frameworks for innovation. These include: engaging multiple stakeholders (beyond a company and users); centring real-life environment; and including co-creating innovation activities. While one paradigm might be emphasized over the others in a given LL, all three must be part of the framework to be considered a LL. The SD4MECS team describe key characteristics of LL as the following: real life environments; stakeholders; activities; business models and networks; methods, tools and approaches; innovation outcomes; challenges; and sustainability.

Figure 9 is an example of a LL approach, implemented by Sahakian et al. (2021) [40], to study reducing household energy use in a European context.

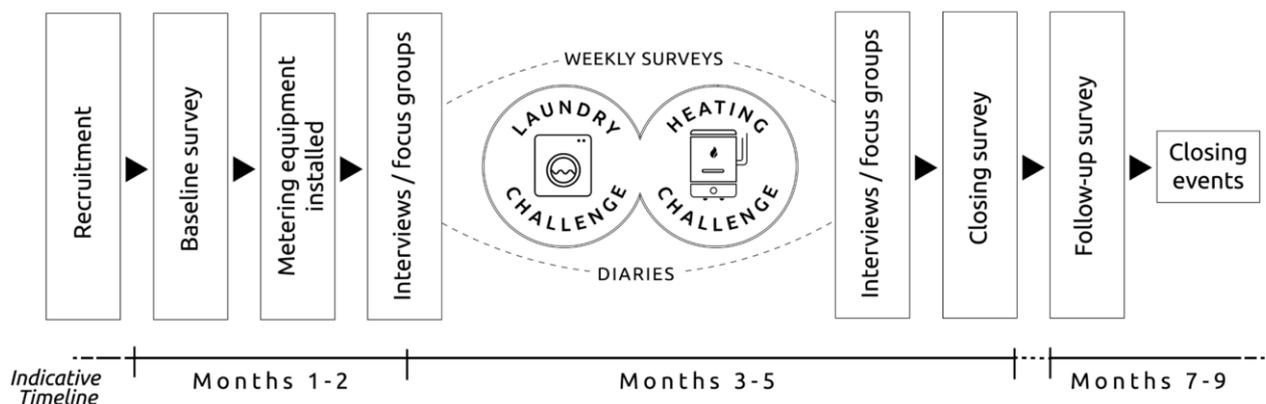


Figure 9: Timeline and process of the practice-centered Living Lab design, from [40]

To understand how LLs emerged to fill a methodological gap, one can look at Ballon et al. (2007) [41], who position LL among Test and Experimentation Platforms (TEPs) which included: Prototyping; Field trials; Societal Pilots; Market Pilots; and LLs. The authors described the relation between the TEPs across three dimensions of focus and maturity, based on a multiple case study in the information technology field, as depicted in Figure 10.

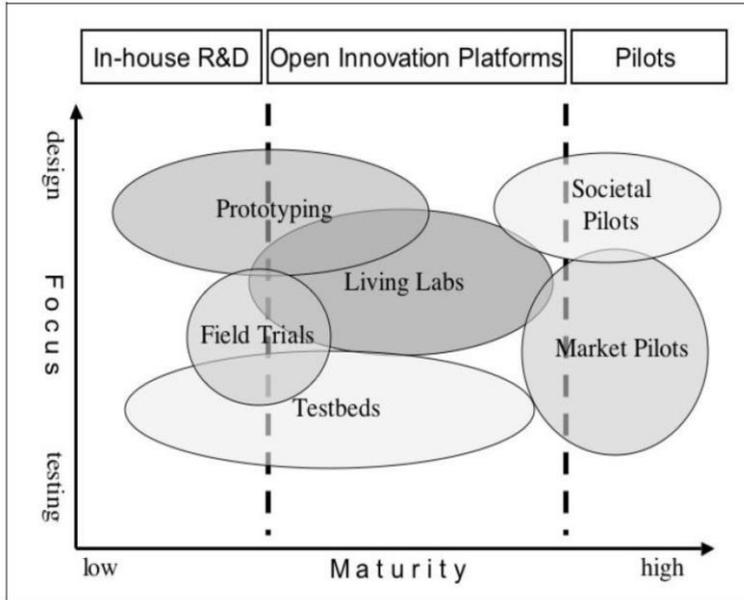


Figure 10: Classification of LL within other TEPs [41]

As LL have proliferated, different types of LLs have emerged, as summarized by [42], in Table 3. The last type, LL for collaboration and knowledge support activities, is, according to the author, “more focused towards multi-stakeholder collaboration and knowledge sharing.” This shift occurred as LLs were implemented in rural areas and started gaining traction outside of Europe, where “Living Labs for collaboration and social development” emerged in LMICs. The focus of LLs on multi-stakeholder collaboration was consolidated with the emergence of the quadruple helix model, depicted in Figure 11, which evolved from the triple helix model, to include the added helix of citizens, as more ecosystems moved to place citizens at the center of innovation [43].

Table 3: Theoretical Living Labs segmentation, from [42] p.151

<i>Original ‘American’ Living Labs</i>	<i>Living Labs as extension to testbeds</i>	<i>Living Labs supporting context research and co-creation</i>	<i>Living Labs for collaboration and knowledge support activities</i>
Abowd et al. (2002), Intille et al. (2008)	Ponce de Leon et al. (2006), Zhong et al. (2006)	Thiesen Winthereik et al. (2009), Ståhlbröst & Bergvall-Kåreborn (2008)	Schaffers et al. (2007), Coetzee et al. (2012), Buitendag et al. (2012),
Laboratory made to resemble the real-world, aimed at data capturing	Test environments within which users and stakeholders can collaborate in the creation and validation of ICT services	Environments aimed to support innovation processes focusing on the early development phases of needs analysis and early design	Multi-stakeholder collaboration, focus on collaborative platforms, knowledge sharing and community development

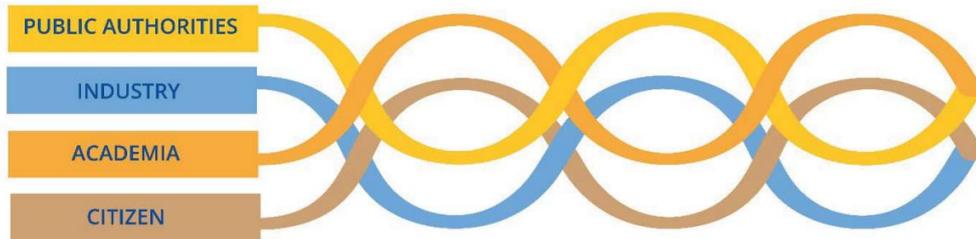


Figure 11: Quadruple Helix Model, from [44]

While LLs seem to be gaining in popularity as a tool, Compagnucci et al. (2021) [43] warn us that the underlying theories of LL are lacking and the roles of various stakeholders of the quadruple helix model in LLs are unclear, needing more research to understand the methods, structures, and practices in LLs.

### How to further enhance the LL approach for MECS, in the future.

#### **More diverse stakeholder groups should be involved in LLs.**

Karanja et. al. (2020) [7] synthesized the views of various expert stakeholders in the clean cooking space in Kenya, focusing on non-end-user stakeholders. The authors found that perceptions of key drivers, barriers, impacts of adoption, and agendas diverged between stakeholders in the field: stove manufacturers, government agencies, research institutes, civil society organizations, international donors, and others.

Usual barriers to adoption were found, including low affordability, low awareness, low willingness to pay for clean cooking, easy access to free traditional fuels, last-mile distribution constraints, and cultural, technical, and environmental barriers. At the macro-level, they found barriers including financing gaps and the slow progress in the development of new cookstoves and fuel options.

Karanja et. al. explicitly call for more studies that involve non-end-user stakeholders, which is supported by many other scholars who have “argued the importance of understanding the interests, agendas, and priorities of wider stakeholder groups involved in the clean stove sector,” including Rosenthal et al 2018; Shankar and Onyura (2015); Sovacool and Dworkin (2015); Lambe et. al. (2015) [45–48].

#### **Adapting the LL framework for Global South contexts.**

Coetzee et al. (2012) [49] describe key differences between LLs implemented in European regions and five Living Labs implemented in South Africa, including an increased focus on collaboration with communities on longer timeframes, which mirrors the literature calling for more community engagement in design for LMICs.

Delina (2020) describes a LL of a “community energy transition in understudied rural Southeast Asia” to increase the visibility of LL approaches in non-Global-North and non-urban settings [50]. The LL was a space where a biodigester was built out of available materials, trialed, and iterated on, to create a source of alternative fuel for cooking, where traditional fuels had become too expensive. The author argues that LL in the Global South might not be characterized as such, despite their clear alignment with the definition used in the paper: a LL is an approach to “generate solution-oriented knowledge through experiments in real-world contexts and to initiate sustainability transformations” [51]. The author defines two aims for the LL, which were an inspiration for the manifesto of the SD4MECS LL:

*“(1) the understanding of the community’s shared sustainability problems, solutions, and processes of change; and (2) the design, application, and testing of solutions—are demonstrated in this exercise.” [50]*

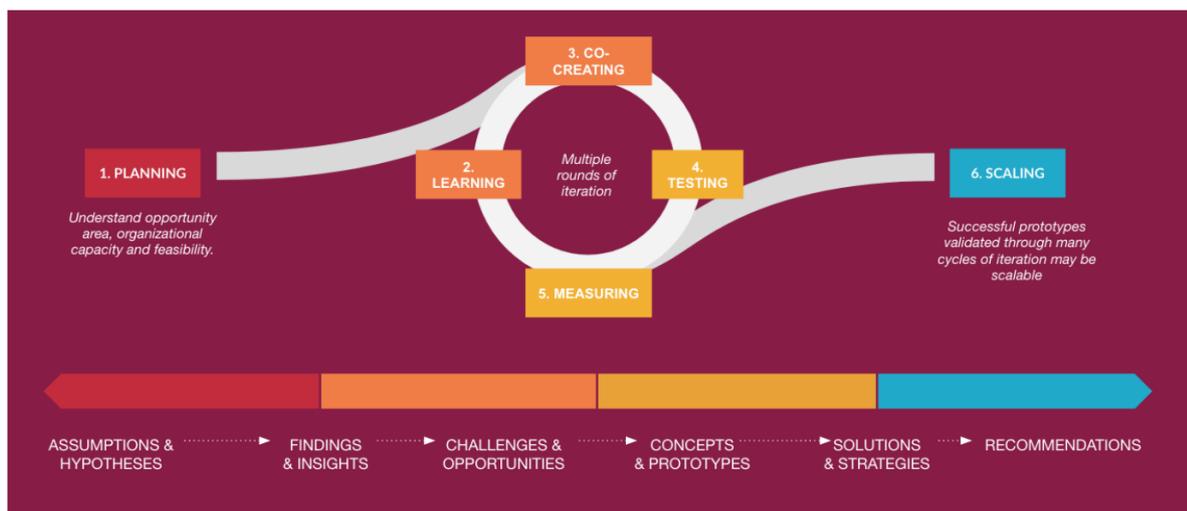
The key learnings from [50] include learning by doing; peer-to-peer learning; and need-based tailored support from external stakeholders. The study and documentation of such examples of successful bottom-up and/or grassroots LL are crucial to developing appropriate methodology for LLs in the Global South.

## Output 1.2: HCD actors in the Global South

**What?** SD4MECS looked for existing applied HCD knowledge in Africa to inform the LL and Journey Mapping toolkits. A key goal was to identify the key industry players contributing HCD knowledge relevant to the East African context, so their research and best practice approaches can be utilised within MECS where appropriate. A selection of actors and toolkits for HCD in Africa is included as a deliverable in Annex 1: HCD toolkits by actors working on the African continent, and Table 4 summarises approaches and toolkits of Sub-Saharan African HCD actors and Figure 12 provides an example of a visual representation of the approach of one of the actors.

Table 4: Approaches and toolkits of HCD actors in Sub-Saharan Africa

Who?	Approach and Toolkit
<a href="#">A360</a>	Full toolkit following: Inquiry; Insight synthesis; Prototyping; Adaptive implementation
<a href="#">Burn Design Lab</a>	Iterative steps of: User Research; Feedback; Development; Prototype; Testing
<a href="#">Dalberg Design</a>	Useful primers on "Remote research and design"; "Remote creative facilitation"; and "HCD and behavioral science integration"
<a href="#">Design for health</a>	10 principles of design and global health
<a href="#">Engage HCD (USAID)</a>	HCD process following the steps of: Immersion; Research; Concepting; Strategy.
<a href="#">Future by design HCD Africa</a>	Toolkit including design ethnography methods (interviews, observations, focus groups) and data analysis methods, adapted to be implemented in a low-resource African context.
<a href="#">iDE Cambodia</a>	Uses the framework of "desirability; feasibility; viability" and their own "Infinite Model: a roadmap to prosperity"
<a href="#">IDEO.org</a>	HCD process following the steps of: Inspiration; Ideation; Implementation. Full Field Guide to Human Centered Design and Online Courses for various designerly approaches.
<a href="#">Kounkuey design initiative (KDI)</a>	Focus on participation: "working with, not for." Work on integration of economic, social, and physical dimensions to create productive public spaces.
<a href="#">Proportion</a>	HCD process following the steps of: Scope; Empathise; Ideate; Prototype
<a href="#">Sonder Collective</a>	Focus on engaging different stakeholders: Communities, Organisations, Implementers and Providers, and Governments.



MEETING PEOPLE WHERE THEY ARE

UNDERSTANDING NEEDS HOLISTICALLY

CO-DESIGNING & ITERATING SOLUTIONS

Figure 12: Example HCD process from one of the actors (Dalberg Design) [52]

**So what?** Most (if not all) of the toolkits for HCD in Africa that the SD4MECS team found and included in the deliverable were created by white designers, and this is also the case for the toolkits that have resulted from the SD4MECS work, thus these works “reinforce global hierarchies” [53]. While academics and researchers in Africa also practice and teach design methods, a discussion is taking place around **decolonizing design, especially in DfD**, and we believe it is primordial for MECS to be aware of and learn from this on-going discussion if the programme hopes to integrate more HCD ways of doing in the future.

The emerging field of DfD [112] has many names. For example, the terms humanitarian engineering [113], engineering for global development [114], design for developing countries, appropriate technology design, design for extreme affordability, and design for the base of the pyramid [115] have all been used. The work in this field spans agriculture, water, poverty alleviation, energy, health, and sanitation [115]. Some fundamental aspects of the field include socio-technical thinking, at the intersection of various disciplines including engineering, sustainable community development, [113], and others.

The field of DfD has developed in part from a Western-centric perspective, where designers are often designing products and services from High-Income Countries (HICs) for use in LMICs.

*‘Many of the design methods, research approaches, tools and even our fundamental [design] epistemologies are rooted in the western mass production ethic.’ [54]*

Designing for people and settings different from oneself is complex and requires that evaluation of our own assumptions and biases [113], especially when there are substantial geographical and cultural gaps. Remote design brings about cultural differences and a more significant divide between designer and end-user [112]. Furthermore, when designing for social impact to address issues rooted in a deep history of inequality and oppression, which is the case for many projects in LMICs, the power imbalances affect design processes and limit opportunities for sustained improvements in social justice [118].

**Now what?** The Decolonising Design group calls for a fundamental rethinking of the discipline:

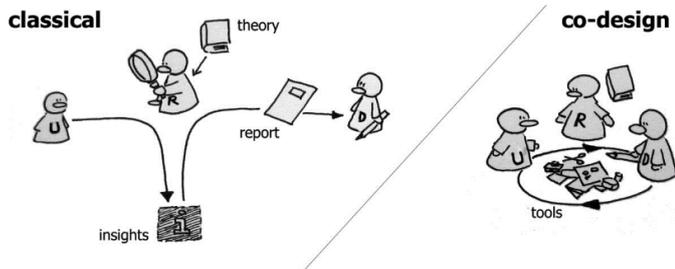
*“We strongly believe that design, as a field of study, has systematically failed to address the questions of power that have shaped its own practice. [...] we want to invite a profound reflection on the devices that constitute our field as it is now, and the types of futures contained in design research and practice.” [55]*

We therefore wish that more voices from black, indigenous, and people of colour be centred in any future design work undertaken for MECS. Some places to start, in addition to the citations from this section, include: Design Justice [56], The Black Experience in Design [57], Global Health Research in an Unequal World: Ethics Case Studies from Africa [58], No White Saviors [59], Muzungus in Development and Governments [60], and Decolonize Peace Corps [61].

## Output 2: Living Lab toolkit

**What?** The LL toolkit contains a conceptual framework for an adaptable MECS ‘LL’ with guidelines for set up, application, and adaptation to different contexts. This toolkit was developed based on the implementation of a LL framework by the SD4MECS team within the CREST field trial. The purpose of the toolkit is to enable application of the LL framework to other field trials of modern energy cooking services within the MECS programme and beyond. The Living Lab toolkit is accessible on the MECS website.

**What would the trial have looked like without LL? What would the trial look like if we started with the LL?**



Sanders and Stappers (2012) diagram of classical vs co-design research [62] (Figure 13) exemplifies the switch that the SD4MECS LL attempted to make happen in the CREST field trial.

Figure 13: Classical vs co-design approach [62]

Two stories given below, illustrate how the SD4MECS approach led to more bottom-up research methods.

**Story 1:** “Just wanted to share an update on a meeting I had with TaTEDO on Tuesday – I asked what they want to get out of the study and what if anything else they think the study could include. Their answer is that their main interest is if battery supported cooking reduces the issue of disrupted cooking due to black/brownouts/unstable grid, that’s an issue they’ve been interested in for a long time. I [...] was thinking do we have a way to measure the number of grid faults these Power Stations help to avoid/would theoretically avoid?” – Tanzania Link Researcher This feedback led to the inclusion of questions related to this research question in the interview protocols and will guide data analysis.

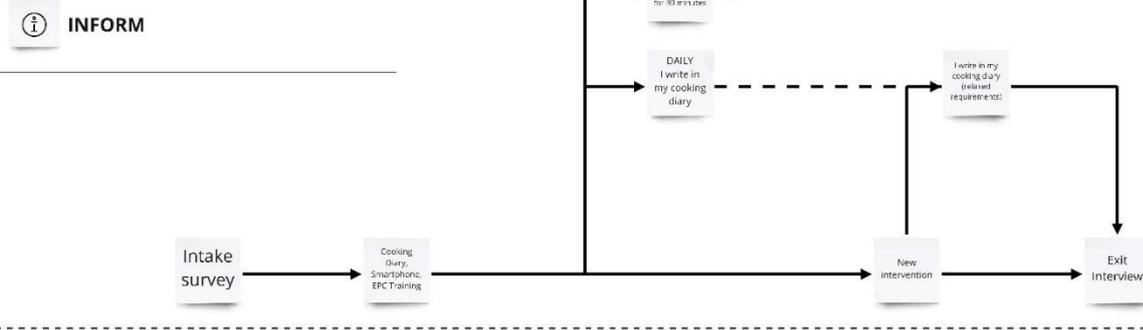
**Story 2:** “While conducting a practice run of the first workshop with the CPs SCODE (pictured in Figure 14) and TaTEDO teams (via Teams because of COVID-19 travel restrictions), I felt like I was finally able to connect with the team and have them actively engaged in designing the LL activities, by providing feedback on the workshop and how to improve it. A key moment for me was when I was able to communicate the shift from top-down to bottom-up research by asking participants what **they** wanted to learn from the trial, thereby having them decide what data we would collect.” – From the perspective of the lead SD4MECS researcher.



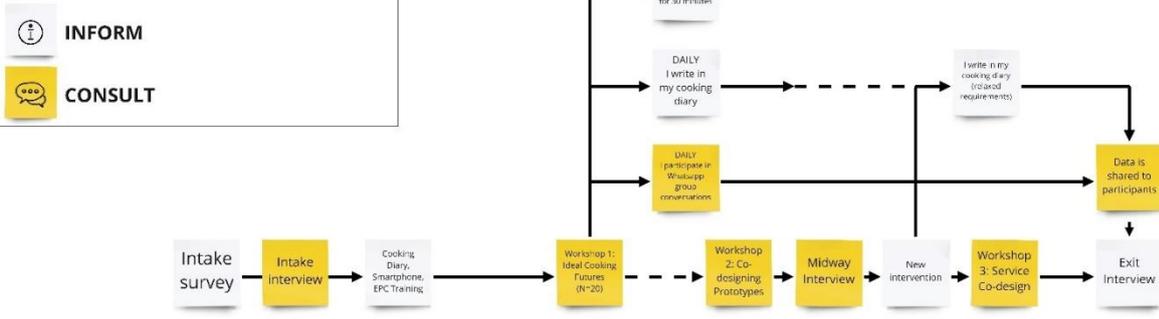
Figure 14: Researcher Dr. Jon Leary carrying out a workshop activity with the SCODE team in Nakuru, Kenya, in Summer 2021.

Figure 15 depicts how the CREST field trial would have looked like without the LL (inform, in white) and some proposed incremental steps to increase the level of active participation of various stakeholders in the research, aiming for a full transformation into a truly participatory LL (in red, empower). While new ‘activities’ are depicted in different coloured post-its, simply adding new and more participatory activities would not suffice, all activities would have to have their underlying approach changed to move from a ‘consult’ approach, towards an ‘empower’ approach.

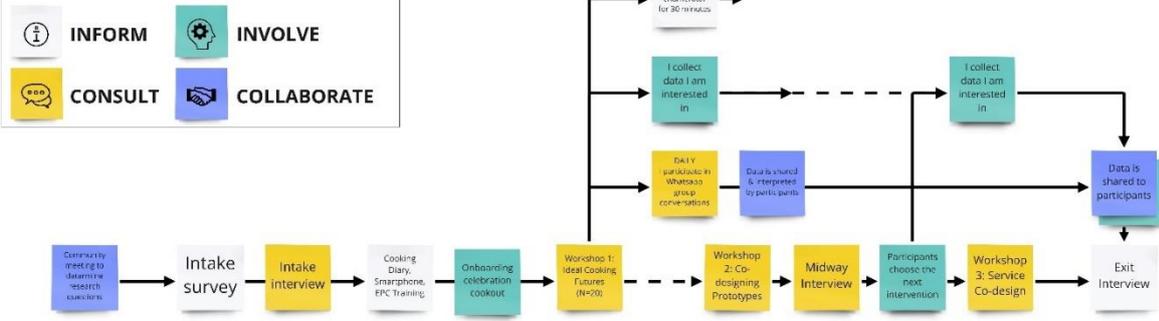
The Technology-Driven Field Trial



The Technology-Driven Field Trial augmented to include HCD



The Field Trial augmented to include HCD and participatory design methods



The Field Trial as a Living Lab

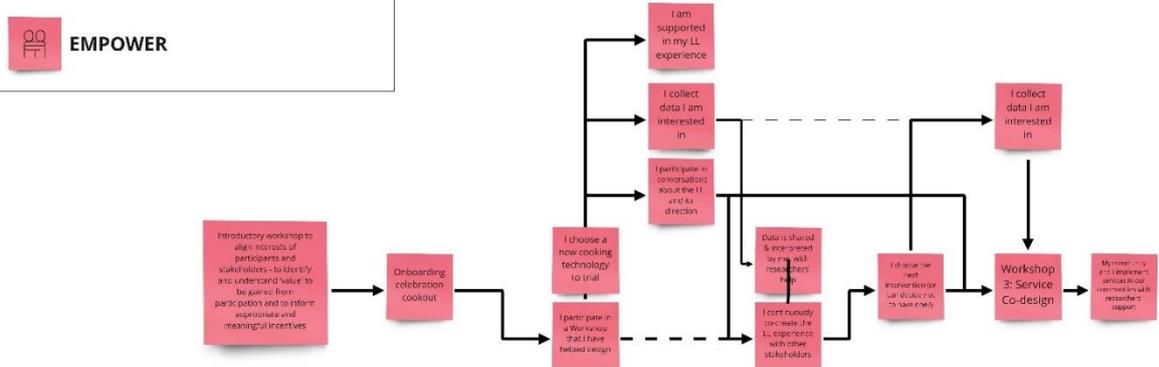


Figure 15: Spectrum of participation applied to the CREST LL

**How might we help future MECS researchers integrate HCD in their studies?**

Figure 16 depicts different levels of collaboration that might be employed in a MECS research study (adapted from [5]). We propose critically reflecting on which level of participation is being aimed for and with which ‘stakeholders’ as a first step towards building more participatory research projects. Additional discussion about Figure 15 and Figure 16 is included in the Living Lab Toolkit.



**SD4MECS Spectrum of Participation** (from IAP2 Spectrum of Public Participation)

The Spectrum assists with the selection of level of participation that defines the non-Western actors' roles in MECS research, including Country Partners, Enumerators, and Participants. The influence that each group has on the process of knowledge creation and outcomes of the process are described along the Spectrum.

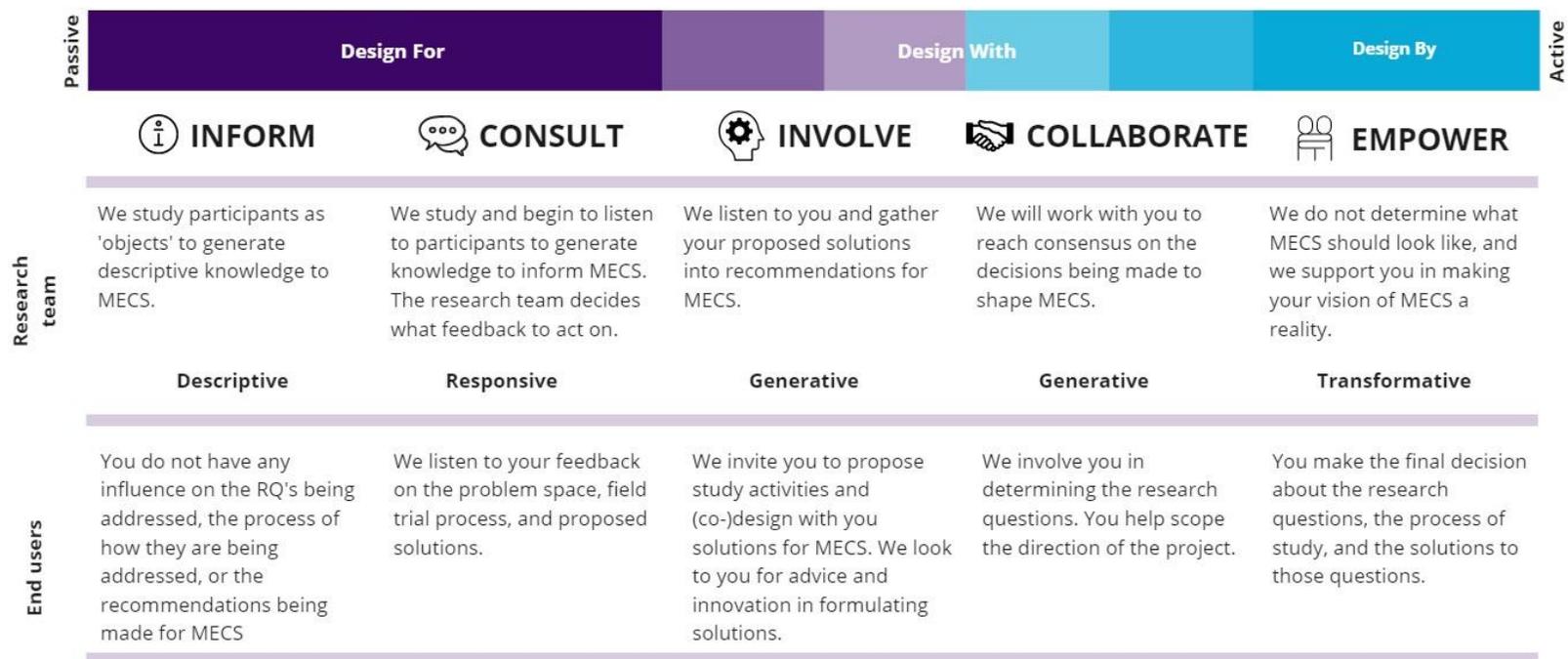


Figure 16: SD4MECS Spectrum of Participation

## Output 3: Journey Mapping toolkit

**What?** The Journey Mapping Toolkit champions the use of Journey Mapping (a SD method) to support further human centred approaches and participatory innovations throughout the MECS programme. This toolkit was developed based on the use of Journey Maps by the SD4MECS team in the CREST field trial LL.

**So what?** The purpose of the toolkit is to enable application of this method to other field trials of modern energy cooking services within the MECS programme and beyond. The Journey Mapping toolkit is accessible on the MECS website. An example journey map of an everyday cook in Nakuru, Kenya, is presented in Figure 17.

 <p>I am the main cook for my family of 5, but my husband sometimes cooks too and helps with chores. I cook breakfast (tea) and supper, sometimes I also cook lunch. I have an improved biomass cookstove, an LPG stove, and a basic biomass cookstove. I use firewood, charcoal, and LPG. I think cooking is important for healthy bodies and for the growth of my kids. I enjoy cooking for my family. When cooking, it is important for me to have leftovers that can be eaten the next day, and to cook food that my children like.</p>		
<p><b>Before</b> (planning, shopping, storing, finding time...)</p> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>I buy mandazis and bread, the rest I cook myself. Sometimes I buy some chips from the streets when in town and I find myself hungry.</li> <li>I always start by looking for mixed vegetables</li> </ul> 	<p><b>During</b> (preparing ingredients, using appliances, waiting, accidents, burning...)</p> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>I cook supper around 7pm when I close my grocery.</li> <li>I wash and prepare vegetables then I light the jiko, and start heating the water. As it heats up, I am cutting the vegetables.</li> <li>When the water boils, I add maize flour and I stir it till it's firm. I then give it time to cook. As it cooks, I now prepare the onions, tomatoes and other spices.</li> <li>When the Ugali is ready, I start cooking the vegies with the same jiko. I usually use one jiko so after I am done with Ugali, I add charcoal and then cook the vegetables..</li> </ul> 	<p><b>After</b> (washing, storing, serving, eating, leftovers...)</p> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>when ready, I heat water on the jiko for cleaning the utensils. After am done with the utensils I am now done, I relax at around midnight.</li> <li>We have leftovers that we eat at breakfast and lunch the next day.</li> </ul> 
<p><b>Likes / positive emotions</b></p> <ul style="list-style-type: none"> <li>I use three stone jiko because it's locally available, with my 50Kshs I can access firewood.</li> </ul>  	<p><b>Likes / positive emotions</b></p> <ul style="list-style-type: none"> <li>I love chopping vegetables</li> <li>I like cooking rice because it is so easy</li> <li>Cooking with wood cooks the food soo quickly and it's fast. Compared with charcoal it saves time.</li> </ul>  	<p><b>Likes / positive emotions</b></p>
<p><b>Dislikes / problems</b></p> <ul style="list-style-type: none"> <li>When it comes to LPG gas, it is costly. So accessing it is not easy and I can't cook all the meals with LPG.</li> </ul>  	<p><b>Dislikes / problems</b></p> <ul style="list-style-type: none"> <li>I don't like lighting the jiko.</li> <li>I don't like stirring Ugali, it makes my arm ache.</li> <li>Cooking with wood creates smoke, inhaling the smoke gets me sick, I am Asthmatic that disturbs me. Charcoal the same. The carbon affects me a lot .putting the jiko inside the house brings alot of carbon that also affects my kids when they are asleep.</li> <li>I have also tried baking cake but it has not made me happy.</li> </ul> 	<p><b>Dislikes / problems</b></p> <ul style="list-style-type: none"> <li>The whole process makes me feel tired</li> <li>I don't have a fridge so I usually place the leftovers somewhere safe because of rats. Sometimes the food spoils and we give it to the dogs.</li> <li>If the food is not cooked enough and I have visitors, I become very frustrated.</li> </ul>  

Figure 17: Example Journey Map created from Interviews with study participants in the CREST field trial.

**Now what?** The toolkit has a selection of examples that describe how to use Journey Mapping within MECS projects, depending on the needs of MECS researchers, as well as some guidelines for how to create journey maps in the context of MECS. Should the reader be interested in Journey Mapping and should want to request extra support beyond the toolkit, we invite the reader to contact directly researchers at the School of Design and Creative Arts that are affiliated with MECS (see Team section).

## Output 4: CREST Living Lab Documents and Materials,

We compiled the associated set of documents titled *CREST Living Lab documents and materials* which contains the main materials that were used to carry out the CREST LL between March 2021 and February 2022. The document includes the recruitment guides, the ethical approval documents (informed consent participant guide; informed consent form; IRB application), the workshop guides (W1, 2, and 3), the mobile research materials (prompt and guidelines), the interview guides (1, 2, and 3), the LL enumerator training materials, the LL timeline representations (GANT chart, study activities sequence, journey map of the study), and the reflection guide.

The document titled *CREST Living Lab documents and materials* should help carry out the remainder of the CREST field trial LL activities and can serve as an example for MECS researchers wanting to implement HCD and LL methods in the future.

From the SD4MECS experience with the CREST trial, several methodological insights have been gathered and are summarized below.

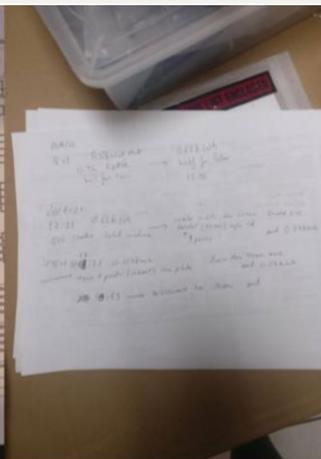
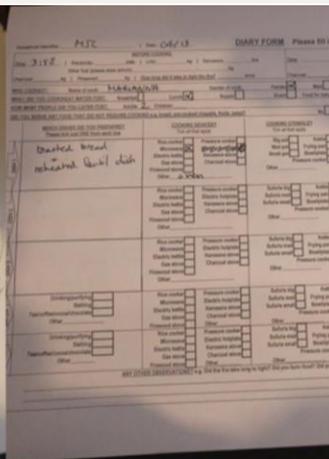
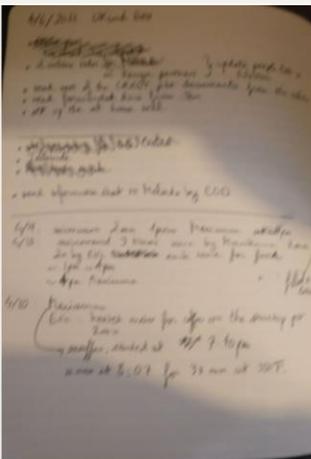
- People are never ready for the intense resources needed for transcription and translation necessary for qualitative methods, especially if expected to take place synchronously with the study. Make sure ample time and resources are set aside for transcribing and translating. The heavy burden of translation can be avoided in part if HCD is designed and implemented by local organisations.
- Keeping up with the data as it floods in is hard, feeding it back into the study is even harder. Prepare in advance what analysis is needed to run on quantitative data and prepare examples for synthesis of qualitative data so that analysis can run faster as the data is collected.
- Early on, working out ways to prioritise different parts of the analysis so that those that are most likely to yield outcomes that will change how future parts of the trial are implemented are done first can drastically change how impactful the trial ends up being. If data is not analysed and shared rapidly, by the time it is shared (on academic timelines, several years after the study is over), the results will be much less useful. Figuring out ways to distil out the most influential findings early on is paramount to successful trials.
- Scheduling regular meetings with CPs, even if you don't have a clear agenda, it is still beneficial: unknown unknowns will surface (examples of unknown unknowns that occurred within the one same week: solar panels were installed in urban households; timeline, sequence, duration of activities misunderstood/miscommunicated; technology malfunction; unexpected participant behaviour reported back).
- Creating cross-country-partner communication is a goldmine: they will ask each other questions that they would not ask you (probably because you wouldn't know the answer).
- Daily updates and feedback were very difficult (impossible) to maintain once the study was running, and feedback on the implementation of a qualitative research method, which typically benefits from iteration as it is being implemented, was not possible for us to achieve without being physically present in country.
- CPs deploying activities at the same time meant we lost the opportunity to learn from one deployment to the next. But the delay in getting DC EPCs in country presented a new opportunity for iteration – use delays and unforeseen changes as opportunities to improve the trial.
- Auto-ethnography: Have you tested the method/tool/survey on yourself and a couple laypeople? Has the test occurred away from your desk/computer? If not, your method/tool/survey is not ready. We depict an example of auto-ethnography tests (Figure 18) that were run early on and helped the SD4MECS team familiarize themselves with the context of the CREST field trial (technology and data collection tools that would be used).

## HUMAN CENTERED DESIGN TOOLS TO BUILD EMPATHY: AUTO-ETHNOGRAPHY



- USED "BATTERY" AS A NEW COUNTER SURFACE  
-> ENDURED SPILLS & CAT POOP
- SUPER SHORT HEATING EVENTS DIDN'T FEEL WORTH NOTING (TEA)  
-> ADAPTIVE REPORT REQUIREMENTS
- PARTNER REPORTED COOKING BEHAVIOR TO ME  
-> COLLABORATIVE REPORTING

14



- COOKING MULTIPLE DISHES AT A TIME  
-> FRUSTRATION OF HAVING A FORM THAT DOESN'T MATCH WHAT I'M DOING
- CHANGED WHAT I COOKED BECAUSE OF THE DATA COLLECTION  
-> PARTICIPANT ROUTINE CAN BE IMPACTED BY DIFFERENT DIFFICULTIES IN RECORDING FUEL USES.

15

Figure 18: Autoethnography conducted by Dr. Marianna Couletianos. A mock Power Station was created and installed in her kitchen, an EPC was purchased, as well as a kWh monitor. Marianna used the EPC as her main method of cooking for several days and completed a paper version of the cooking diaries to mimic what participants of the CREST field trial would go through.

## Stakeholder maps

**What?** “Stakeholder maps help to visually consolidate and communicate the key constituents of a design project, setting the stage for user-centred research and design development.” [63], p208. SD4MECS used stakeholder maps to explore who were the actors of the CREST LL (Figure 19) and created a speculative map for the everyday cook (

Figure 20).

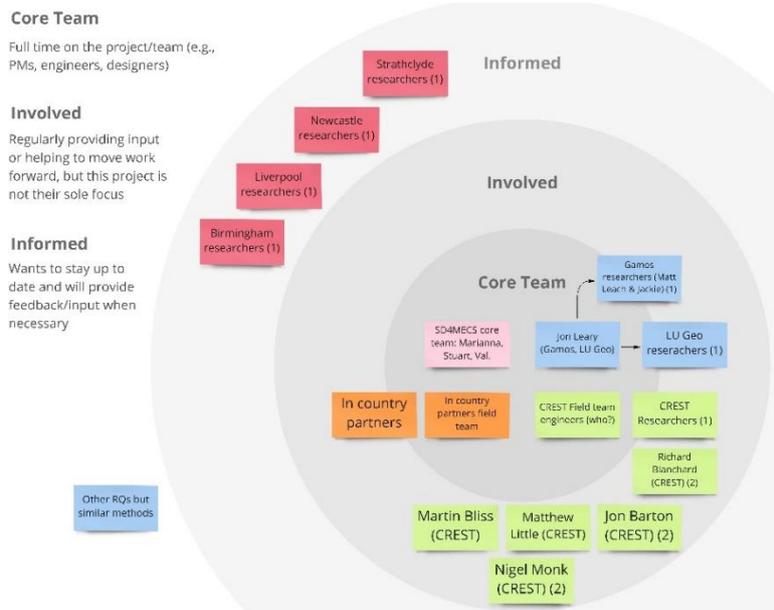


Figure 19: CREST field trial stakeholders

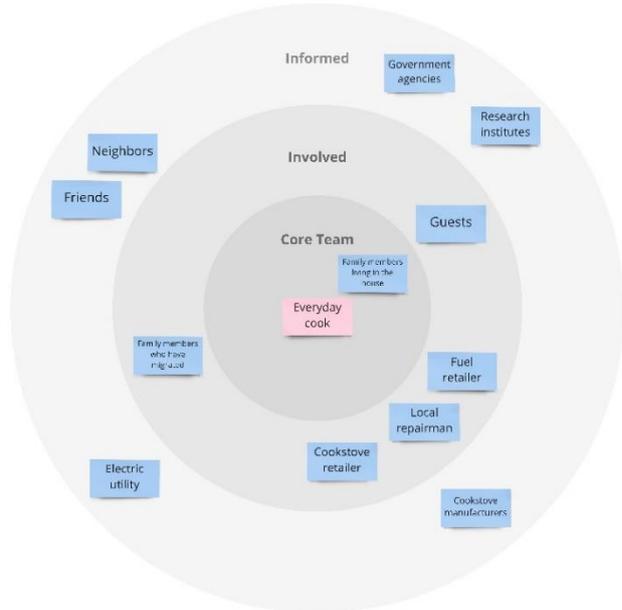


Figure 20: Everyday cook stakeholder map

**So what?** The above-mentioned stakeholder maps helped SD4MECS consider a wide variety of stakeholders when developing tools. For example, when developing the qualitative interview protocols, the team looked at the everyday cook stakeholder map to make sure questions were being asked about the people who ‘surround’ the cook on the map and their experience with the technology being tested as it related to the everyday cook (the study participant).

**Now what?** Creating actual maps of the stakeholders surrounding the CREST LL stakeholders and the everyday cook, based on the data collected in the field trial, will reveal which stakeholders were overlooked and which were included by mistake. This process could help researcher identify blind spots and self-reflect on biases that will have affected the study and could provide avenues for future research.

Knowledge and templates for creating Stakeholder Maps are accessible through the School of Design and Creative Arts (Figure 21).



Figure 21: Aperçu of a Miro template for Stakeholder Mapping

## Ethics: How can we design a trial around ethics?

**What?** The SD4MECS team was the advocate of the everyday cooks in the CREST field trial and have raised issues of ethics, a selection of which is given below. All ethics materials are included in the [CREST field trial LL document](#).

- Submitted the IRB application to the Loughborough board and supported CPs in securing local approval. Notably, SD4MECS created the Informed Consent Form and the Participant Information Sheet through consultation with Dr. Melinda Barnard-Tallier (Gamos anthropologist). The documents were translated into Swahili by CPs and used to formally recruit participants.
- Reviewed the proposed participant incentives to make sure they were fair for participants and would not raise concerns from the IRB. The SD4MECS team compared the time participants would spend on study activities compared to the monetary equivalent of the incentives. Both were then compared using an approximation of the local salary hourly rate. Incentives were then confirmed with CPs, equalized across urban and rural participants, and across countries. An example of the incentives calculation is given in Table 5.
- Learned about the work of housemaids in Kenya and Tanzania, discussed ethical implications of including participants who have a housemaid, strongly recommended avoiding recruitment of any households employing housemaids.
- Advocated for the security of the participants throughout the study and maintained the IRB approval amid the multiple changes that occurred.
- Raised issues of fairness in the burden of translating study materials into local languages between CPs and advocated for an even spread of the burden.

Table 5: Example incentive estimation

*We calculated the estimated time spent on study activities, including onboarding (4 hours), cooking diaries (1h/day in two week increments 3 times), check-ins with enumerators (30min/day for the first 2.5 weeks of the study), participation in the WhatsApp group conversations (15 min a day for up to a year), workshops (3 workshops of a full day each with 1 hour transportation time), mid-point survey (1 hour), exit activities (4 hours), for a total of 258 hours per participant. A daily rate range of 10-30K (17,333 according to the salary explorer website) was used to estimate a fair payment to participants for their time in local currencies. Hence, the total remuneration per participant was expected to be around 198 in Great British Pounds (GBP). Incentives provided for weak-grid (urban) participants include electricity costs covered (GBP28.55), gifted appliance (GBP57.15), smartphone (GBP80), for a total of GBP165.70. Incentives provided for off-grid (rural) participants include electricity costs covered (equivalence, BP28.55), gifted solar lanterns (GBP66.65), smartphone (GBP80), for a total of BP175.20. We therefore suggest that participants be compensated the extra GBP23 in an appropriate form.*

**So what, now what?** Several factors contributed to SD4MECS researcher taking on this role: the HCD grounding of SD4MECS positioned the team as the advocates for participants, and more generally for all field trial stakeholders; SD4MECS led and facilitated collaboration with trial stakeholders; no one else seemed to have this role before the SD4MECS were onboarded. However, unexpected issues still arose, such as the gender dynamics in the participant households which in some cases interfered with participation. We therefore would encourage more dialogue with CPs who have local knowledge that could have been better centred and leveraged and we suggest defining a clear role related to ethics, with a mission and supporting frameworks to ensure MECS field trials are aware of and mitigating ethical issues that will arise.





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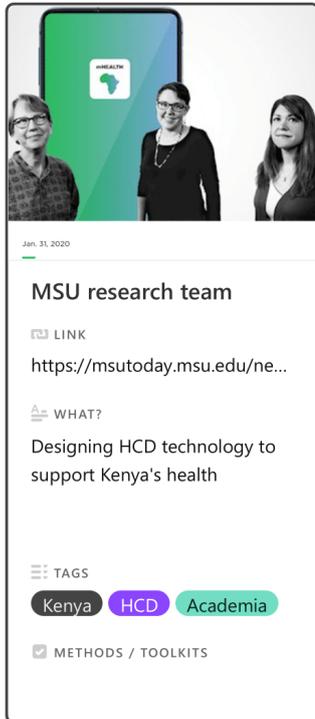
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# Annex 1: HCD toolkits by actors working on the African continent

The full list of actors and links to the toolkits can be seen [here](https://airtable.com/shrC7lBmU2QAbloXL): <https://airtable.com/shrC7lBmU2QAbloXL>



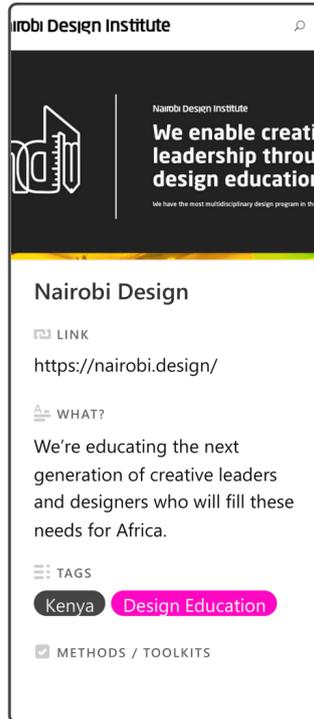
**MSU research team**

LINK  
<https://msutoday.msu.edu/ne...>

WHAT?  
Designing HCD technology to support Kenya's health

TAGS  
Kenya HCD Academia

METHODS / TOOLKITS



**Nairobi Design Institute**

We enable creative leadership through design education

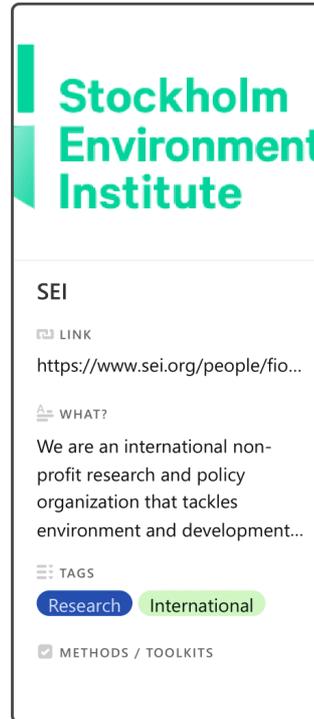
**Nairobi Design**

LINK  
<https://nairobi.design/>

WHAT?  
We're educating the next generation of creative leaders and designers who will fill these needs for Africa.

TAGS  
Kenya Design Education

METHODS / TOOLKITS



**Stockholm Environment Institute**

**SEI**

LINK  
<https://www.sei.org/people/fio...>

WHAT?  
We are an international non-profit research and policy organization that tackles environment and development...

TAGS  
Research International

METHODS / TOOLKITS



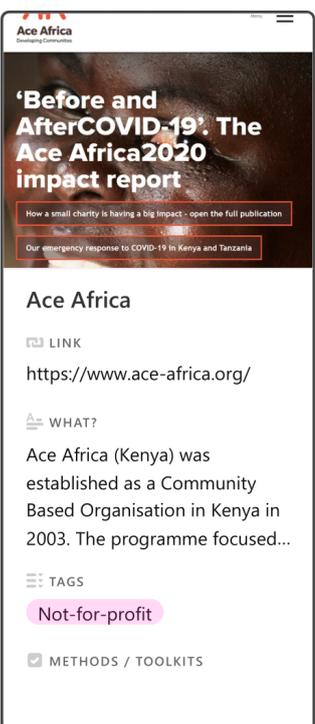
**The innovation village**

LINK  
<https://innovationvillage.co.ug...>

WHAT?  
We are an ecosystem builder at the heart of an interconnected network of entrepreneurs, academia, private sector, ...

TAGS  
Entrepreneurship

METHODS / TOOLKITS



**Ace Africa**

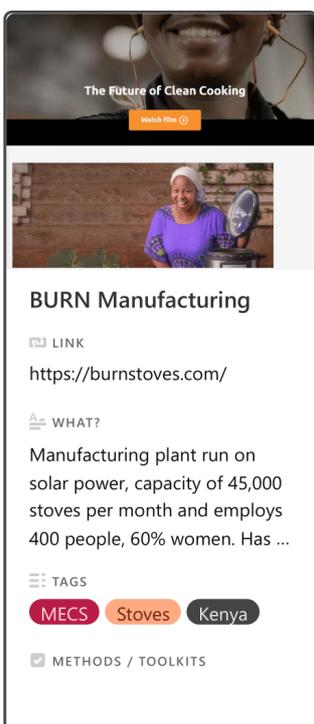
'Before and After COVID-19'. The Ace Africa 2020 impact report

LINK  
<https://www.ace-africa.org/>

WHAT?  
Ace Africa (Kenya) was established as a Community Based Organisation in Kenya in 2003. The programme focused...

TAGS  
Not-for-profit

METHODS / TOOLKITS



**BURN Manufacturing**

The Future of Clean Cooking

LINK  
<https://burnstoves.com/>

WHAT?  
Manufacturing plant run on solar power, capacity of 45,000 stoves per month and employs 400 people, 60% women. Has ...

TAGS  
MECS Stoves Kenya

METHODS / TOOLKITS



**CESET**

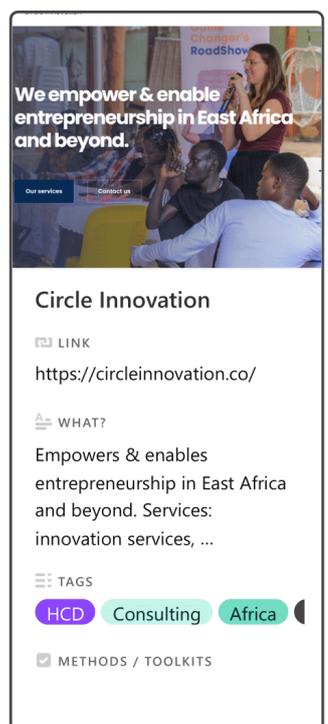
Community Energy and the Sustainable Energy Transition in Ethiopia, Malawi and Mozambique

LINK  
<https://cesetproject.com/>

WHAT?  
Community Energy Systems and Sustainable Energy Transitions in Ethiopia, Malawi and Mozambique (CESET)...

TAGS  
Ethiopia Malawi Mozambi

METHODS / TOOLKITS



**Circle Innovation**

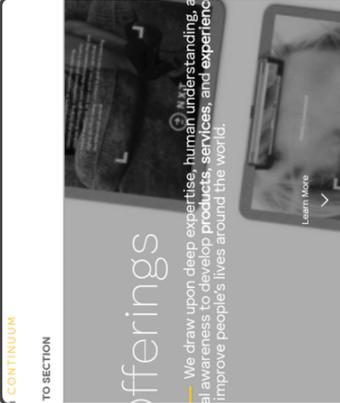
We empower & enable entrepreneurship in East Africa and beyond.

LINK  
<https://circleinnovation.co/>

WHAT?  
Empowers & enables entrepreneurship in East Africa and beyond. Services: innovation services, ...

TAGS  
HCD Consulting Africa

METHODS / TOOLKITS



**Continuum innovation**

**LINK**  
<https://www.continuuminnovat...>

**WHAT?**  
 Global innovation design firm. Worked on a micro-insurance project in Kenyan slums in partnerships with others. ...

**TAGS**  
 Consulting Kenya

METHODS / TOOLKITS



**HCD exchange**

**LINK**  
<https://hcdexchange.org/>

**WHAT?**  
 "Advancing learning and evidence on design-led adolescent sexual health"

**TAGS**  
 HCD health Kenya

METHODS / TOOLKITS



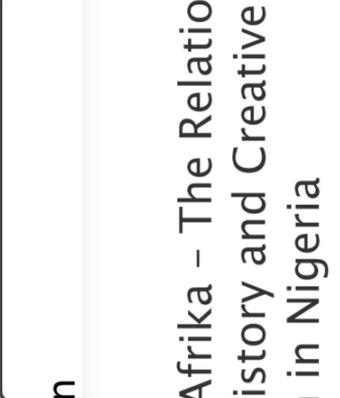
**iHub**

**LINK**  
<https://ihub.co.ke/>

**WHAT?**  
 We are an innovation centre dedicated to accelerating the application of social technology for economic ...

**TAGS**  
 Entrepreneurship Kenya

METHODS / TOOLKITS



**LANI ADEOYE**

**LINK**  
<https://www.if-designfoundati...>

**WHAT?**  
 Furniture design + essay on future of design education in Nigeria: Designing Design Education. White Book on the ...

**TAGS**  
 International Design Education

METHODS / TOOLKITS