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Investigating Innovation Practice: Cross-Disciplinary Studies in International Development

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Investigating Innovation Practice: Cross-Disciplinary Studies in International Development

by

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Abstract

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Innovation practice is a transdisciplinary field that aims to create a better world out of an existing one by pooling methods and mindsets of inquiry and creation. The field observes design contexts, assimilates the collected knowledge into problems to be addressed, ideates solutions to those problems, and iteratively tests those solutions in real environments to determine how they address these problems. Over the past decade, the field has become more accessible to a much broader collection of amateur designers. They utilize the field to understand more diverse contexts, to include and adapt more disciplines, and to address a wide variety of complex and seemingly intractable issues. Due to the evolution of the fields' popularity, debates began to arise about the fields' utility and place in society. Development professionals treated design thinking and related fields as a silver bullet that could easily address issues of global poverty. Critics asked if the field was different from existing disciplines, whether the field delivers demonstrable impact, and if the democratization of design practice to 'amateur' designers is even worthwhile. However, these debates revealed how little knowledge is collected about how practitioners conduct innovation practice in the first place. To learn about the activities, benefits, methods, and obstacles of beneficial development-focused design practice, I detail three studies that apply lenses of analysis to innovation narratives to see how various collectives of self-determined innovators actually practice their craft.

The first study outlines a systematic literature review of human-centered design for development. By applying design principles to a population of researcher-designers and their narratives, we learn if these designers actually practice innovation with these principles of human-centeredness in mind. I outline three previously conducted studies about the nature of this field, which describe the population, location, history, and methods these projects use across various contexts. and detail an analysis of the participatory nature of human-centered design for development. In so doing, I describe statistics about the prevalence of participatory design practice, reveal how the studies report the complexities of participation, and collect insights about the stakeholders who are allowed to design. The study then sums up the importance of investigative analysis methods across populations of design narratives, so that researchers can learn more about how 'good practice' is perceived.

The second study describes an ethnographic evaluation study of notable actors in the Botswana innovation community. This study begins with a reflection on epistemological frictions between the popular fields of innovation practice and impact evaluation. After revealing the theoretical and practical gaps in how innovators evaluate, I introduce the Botswana history, policies, and institutions that support innovation practice on the national level, while describing their activities and how innovation actors perceive them. I then detail the creation of a grassroots innovation community that practices participatory co-design of locally beneficial technologies by outlining the history of its indigenous stakeholders and describing an ethnographic narrative of two formative innovation workshops. I then describe the methods, approaches, purpose, and stakeholders involved in the evaluation of innovation in the local and national institutions. This analysis reveals evaluation tools applicable to many innovation contexts, and insights about how these evaluation approaches are aligned and misaligned with each other. Finally, I describe insights on the practice and facilitation of innovation in the country, to clarify cultural, institutional, and practical barriers and qualities that hinder the potential benefit of innovation.

The final study is a reflection on the inadequacies of ethics systems in Botswana to support beneficial innovation practice. While investigating the previous chapter, I happened upon narratives with no simple solutions, and few resources for development-centric designers to effectively navigate this ethics space. Moreover, while facing the country's institutional review board system, I gained first-hand experience with the goals, dynamics, and limitations of the Botswana research system of ethics. This chapter unpacks how the ethical system fails to align with the needs of beneficial innovation practice and suggests theoretical alternatives to draw upon for future use.

This dissertation describes the complex possibilities of participatory design practice, the various goals, activities, and perceptions of the evolving Botswana innovation ecosystem, and details the frictions between the understudied field of ethics in design for development and existing institutions. These studies reveal how 'good' innovation practice is wholly based on the context it is applied: on its practitioners, their tools, their goals, the environment where it is used, and the stakeholders with whom the designers interact. Though these studies outline how the methods and mindsets of innovation practice are accessible to more communities than ever, it does not mean that innovation practice itself becomes simpler. These lenses of cross-contextual analysis, participation, evaluation, and ethics reveal how the amorphous, evolving field requires innovators who are responsive and respectful of the contexts in which they are situated. These studies outline a few of many approaches that reveal the unique dynamics in development-centered innovation practice but are essential for any designers' toolbox to ensure we collectively create a better world.

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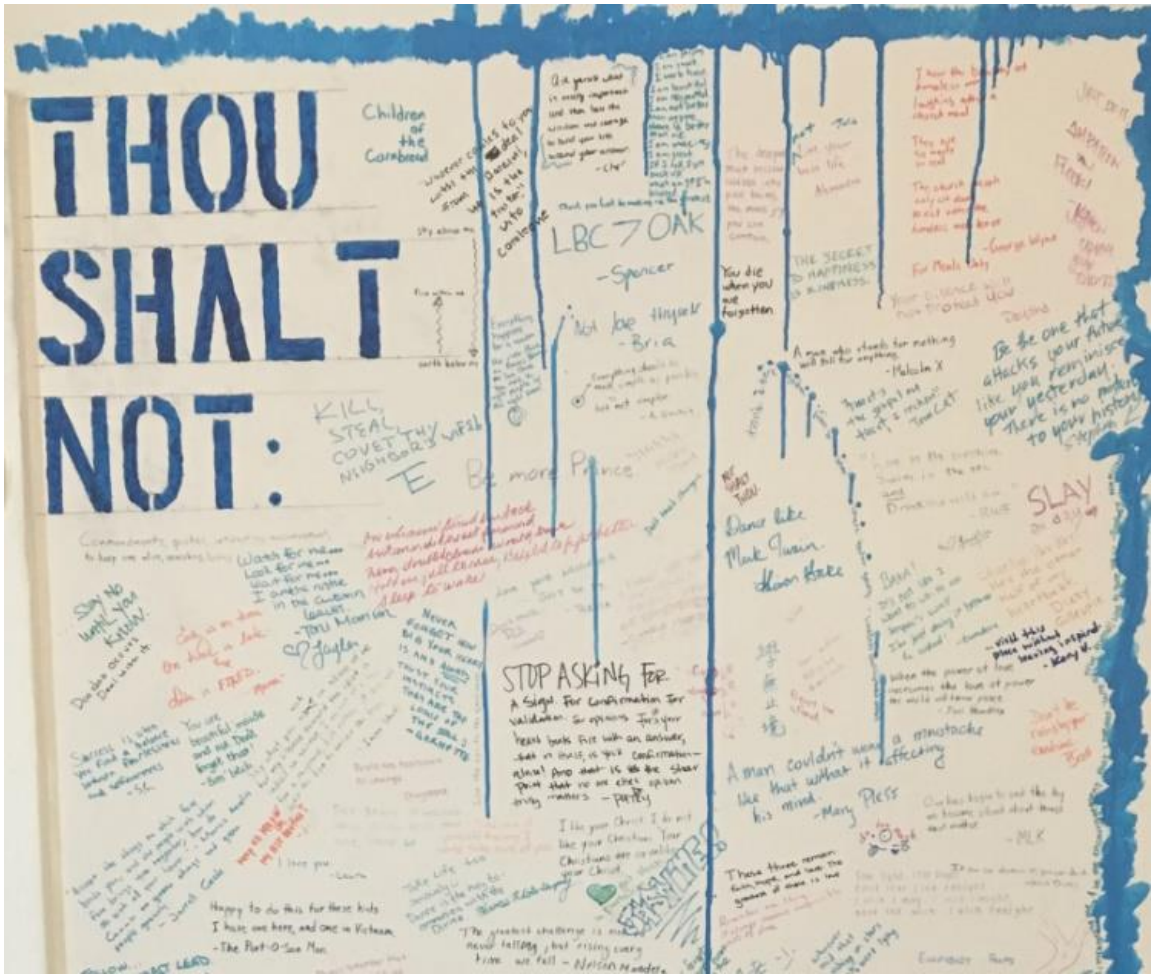
During my graduate school experience, anyone who would enter my apartment for the first time in North Oakland would be asked to write on the wall. The people who did so ranged from one-time acquaintances, to lifelong friends, to ex-lovers and family members. Most everyone had advice to give, and I am forever grateful for each nugget of appreciation they have offered.



As everything in an apartment, however, this wall had to be painted over. As I reflect on its presence in my life, I cannot be sad about its temporary nature, the wall delighted all visitors, taught life lessons to all who contributed to them, and reminded me of all the relationships I had built during this doctoral journey. For everyone who signed the wall, thank you. For everyone who has been influential on this path, thank you. For my friends, my antagonists, my support and my sounding boards, thank you.

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To my love, Monkgogi Bonolo Otlhogile, for being my puzzle piece. Time for the rest of our lives.

For the world’s innovators.

Contents

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List of Abbreviations

A&M – Texas A&M University

AIDS – Acquired Immunodeficiency Syndrome

AIF – Africa Innovation Foundation

AIO – African Innovation Outlook

AMCOST – African Ministerial Council on Science and Technology

AMPATH – Academic Model Providing Access to Healthcare

AOSTI – African Observatory of Science, Technology, and Innovation

ASTII – African Science, Technology and Innovation Indicators

AU – African Union

BIF – Botswana Innovation Fund

BIH – Botswana Innovation Hub

BITC – Botswana Investment and Trade Centre

BITRI – Botswana Institute of Technology Research and Innovation

BIUST – Botswana International University of Science and Technology

BOTEC – Botswana Technology Centre

BURS – Botswana Unified Revenue Services

BWP – Botswana Pula

CAP – Companies Act

CBD – The Convention on Biological Diversity

CBPR – Community-Based Participatory Research

CCB – Creative Capacity Building

CEO – Chief Executive Officer

CESPAM – Centre of Specialisation in Public Administrator Management

CESRIKI – Centre for Scientific Research, Indigenous Knowledge and Innovation

CIPA – Companies and Intellectual Property Authority

CIS – Eurostat Community Innovation Survey

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora

CKGR – Central Kalahari Game Reserve

CONDEV – Center on Conflict and Development

DESIRE – Decision Support and Integrated Record-Keeping

DFID – Department for International Development

DRST – Department of Research Science and Technology

DTC – Diamond Trading Company Botswana

EPF – Economic Promotion Fund

FMDV – Foot-and-mouth disease virus

FSVC – First Steps Venture Center

GCI – Global Competitiveness Index

GDP – Gross Domestic Product

GO-SPIN – UNESCO's Global Observatory of Science, Technology and Innovation Policy Instruments

GSSE – Global Social and Sustainable Enterprise

HCD+D – Human–Centered Design for Development

HCI – Human-Computer Interaction

HESN – Higher Education Solutions Network

HIV – Human Immunodeficiency Virus

HRDC – Human Resource Development Council

IASP – International Association of Science Parks

ICSID – International Council of Societies of Industrial Design

ICT – Information and Communication Technologies

IDDS – International Development and Design Summit

IDIA – International Development Innovation Alliance

IDIN – International Development Innovation Network

IDP – Internally Displaced Persons

IMS – Incident Management Systems

INSEAD – Institut Européen d'Administration des Affaires, or the European Institute of Business Administration

IP – Intellectual Property

IPA – Innovation Prize Africa

IRB – Institutional Review Board

ISO – International Organization for Standardization

J-PAL – Abdul Latif Jameel Poverty Action Lab

KDT – Kuru Development Trust

KFO – Kuru Family of Organizations

KLM – Koninklijke Luchtvaart Maatschappij – Royal Dutch Airlines

LEA – Local Entrepreneurship Authority

LEED – Leadership in Energy and Environmental Design

LSD – Lumpy Skin Disease

LUMA – Looking, Understanding, and Making Institute

MDG – Millennium Development Goals

MIT – Massachusetts Institute of Technology

MITI – Ministry of Investment Trade and Industry

MOU – Memorandum of Understanding

MP – Member of Parliament

MTC – Ministry of Transport and Communication

NAFTEC – National Food Technology Research Centre

NCCEE – National Conference on Citizen Economic Empowerment

NEPAD – New Partnership for African Development

NGO – Non-Governmental Organization

NHRDS – National Human Resource Development Strategy

NORAD – Norwegian Agency for Development Cooperation

OECD – Organisation for Economic Cooperation and Development

ORD – Office of Research and Development

ORI – Okavango Research Institute

PAR – Participatory Action Research

PRA – Participatory Rural Appraisal

RADP – Remote Area Development Programme

RIPCO – Rural Industries Promotions Company

RPI – Research Policy Institute

RSTI – Research, Science, Technology and Innovation

SADC – Southern African Development Community

SARIMA – Southern African Research & Innovation Management Association

SDG – Sustainable Development Goals

SEED – Stanford Institute for Innovation in Developing Economies

SEZ – Special Economic Zones

SIDA – Swedish International Development Cooperation Agency

SIEF – Strategic Impact Evaluation Fund

SMME – Small, Medium and Micro Enterprises

STI – Science, Technology, and Innovation

STP – Science and Technology Park

SWOT – Strengths, Weaknesses, Opportunities, and Threats

TGLP – Tribal Grazing Land Policy

TPP – Technological Product and Process

TRL – Technological Readiness Level

UAE – United Arab Emirates

UB – University of Botswana

UBCSHA – Centre for Study of HIV&AIDS

UNDP – United Nations Development Programme

UNESCO – United Nations Educational, Scientific and Cultural Organization

UNICEF – United Nations International Children's Emergency Fund

UNIDO – United Nations Industrial Development Organization

UNISA – University of South Africa

US – United States

USAID – United States Agency for International Development

WIMSA – Working Group of Indigenous Minorities in Southern Africa

WTISD – World Telecommunications and Information Society Day

Points of Linguistic Clarification

In different parts of this dissertation, designations are used for certain members of the citizenry from Botswana. The people (plural) from the country are called Batswana (pronounced roughly as the -bot in robot), and a citizen (singular) from the country is called a Motswana (pronounced roughly as the mo- in moat). When describing the culture of the country and its people, the designation Tswana is used. Moreover, multiple languages spoken in the country do not have a single way to spell certain words. Certain words from the country might be spelled similar ways (Ghanzi and Gantsi, Khoesan and Khoisan), but have the same meaning.

The words used to designate the historically semi-nomadic original denizens of the Kalahari Desert are adaptive and contextual: the 'correct' word depends on the speaker, and to whom they are speaking. Such terms include: Basarwa, Bushman, San, RADs, Khoisan, and the Kua, each with their own historical experience, their popularity in academic, activist, or indigenous circles. According to Kiema, there are no designations of this indigenous community that are widely accepted and understood; all names have a history in marginalization and oppression. An in-depth explanation of meanings and histories of many of these words, located in this text [1]. These designations represent a collection of communities each with their own distinct cultures, languages, and religions from each other. However, they all have similar marginalized and tensioned relationships with other Batswana, the Botswana government, expatriate representatives, and the outside world. Because most of these citizens in D'kar with whom I directly communicated in this project introduced themselves as San and asked to be described as San communities in our correspondences, I describe them in this dissertation as the San people.

Additionally, the text in this dissertation is written with American spelling. However, Botswana, and much of the cited text in the document, write using British English spelling standards. To ensure the quotes are accurate, the spelling from sources in British English is retained in the text.

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Chapter 1 | Innovation + Development

“Innovation, in Setswana, roughly translates to two words: *bonokopila*, which means excellence, and *maranyane*, which means technology.”

- Prof. Thapelo J. Otlogetswe

“There does not exist a word meaning exactly innovation [in Naro], but I use the word *sonkori* which literally means dreams…”

- Mathambo Ngakaeaja

Figure 1: Outside D'kar.

I stumbled upon the field of innovation, like many other practitioners, while searching for something else. After finishing a dual-degree program in applied physics and aerospace engineering, however, I felt intellectually naked, without the tools or the direction to learn more about what I wanted to accomplish. My graduate training in the Energy and Resources Group offered me the opportunity to develop a transdisciplinary perspective on international development by taking courses, signing onto projects, visiting countries, and learning from colleagues so I could find out about the dynamics and difficulties of global poverty. That search found me in projects related to sanitation in informal settlements in Kibera, to investigating innovation practice in Botswana, to discussing the difficulties of determining the impact of traditional international development projects. As I searched, I became drawn to approaches that attracted these disciplines together. Each of these communities proclaimed how vital it was to be innovative, without defining what it meant to do so. In this I reflected on the questions from my peers: what is innovation, and how do people practice it?

Where did Development-Centered Innovation Practice Come From?

The practice of design predates humanity; the ability to make things towards a useful goal is considered the characteristic that differentiates humans from other species. According to Manzini, in Design, when Everybody Designs, the word design entered the English language in the year 1500. In 1548 the first written citation of the verb "design" was outlined, defined as "to concede and plan out in the mind; do you have a specific purpose; to devise for a specific function or end." The word as a noun, however, wasn't introduced in dictionaries until in 1588, defined as "A particular purpose held in view by an individual or group; deliberate, purposive planning; a mental project or scheme in which means to an end are laid down [2]."

This outlines the age of two of the primary ways that design practice is described: first as a process, and second as a plan. Eventually, two additional designations would be included: design as a product, a thing that was created through the purposive process of design; and as a field a community with the history of people who aim to practice, theorize, critique, and understand design as a whole. The foundations of design have many roots, and though the scholars might not call it innovation or design, they undoubtedly contribute to how the field was shaped. One scholar of note was the eighteenth-century Italian scholar Gambattista Vico. Considered the "grandfather of constructivism," he was a philosopher and a university administrator and designer of legal structures. As one who deeply understood what it takes to design social realities, not just the material artifacts supportive of them, he took issue with René Descartes' belief that "the mind was an organ whose function was to represent the world that existed outside of it as accurately as possible." Instead, he argued that "human knowing results from doing, from creating things, from constructing the world one lives in….one could interpret Vico's New Science as providing a human-centered epistemology that is grounded in design activity, not in detached observation. One convincing proof for this principle is the absolute certainty of mathematics, which he correctly identified as a human invention, not a reflection of nature [3]."

As professions go, however, design is relatively young. Though people have been designing tools, governmental structures, cultures, food, and everything else that makes their world for much of history, people either made things by themselves, they found someone to make it for them. The design profession, however, evolved due to the rapid improvement of manufacturing capabilities of the Industrial Revolution in the 18th and 19th centuries, which required institutional shifts towards mass producing identical goods. For the first time, the act of designing the tools became separate from the process of making them, and industrial design was birthed out of this need [4].

However, though there were scholars who made contributions to the debate on theory, methodology, and the process of design practice, the history of design as a transdisciplinary field and systematic process started in 1968, with Simon's Sciences of the Artificial. In this canon text, he defined a designer as one "who devises courses of action aimed at changing existing situations into preferred ones. It outlines the field as the core of all professional training: it is the principal mark that distinguishes the professions from the sciences. Schools of engineering, as well as schools of architecture, business, education, law, and medicine, are all centrally concerned with the process of design [5]." By laying the design's groundwork as a field that can be investigated using scientific methods, future luminaries then built up the qualities and framework of beneficial design practice over time. Towards this end, Di Russo's *Understanding the Behaviour of Design Thinking on Complex Environments* narrates an exceptional history of design thinking, which

includes critical themes of design as attacking complex and 'wicked problems', design as a human activity and concept, design as an intuitive act, design requiring introspection, design as innovation, and many other qualities [6].

How is innovation practice defined? In the field today, there is a litany of definitions, methods, approaches, principles, and communities that aim to circumscribe innovation practice. One framework of note is outlined by Beckman and Barry's "Innovation as a Learning Process: Embedding Design Thinking," that develops a theory of design as a learning model and describes narratives on how people can move through the process. Figure 2 shows the foundational framework from the text.

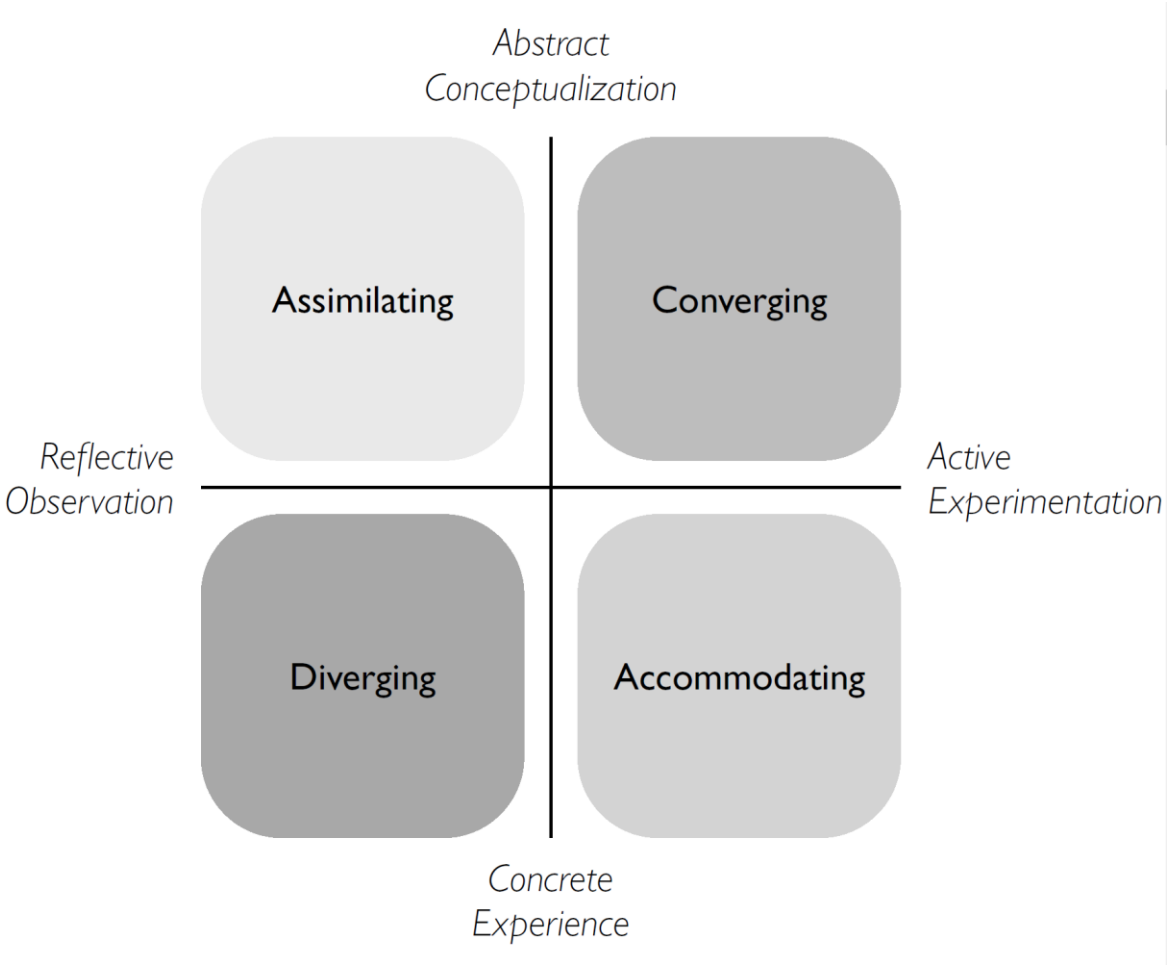


Figure 2: Learning Methods for Design Thinking [7].

In the text, the authors outline how design requires *divergence*, where designers can observe a problem-laden context in an ethnographic manner, *assimilation*, where they collect and analyze the data into knowledge and issues to be addressed, *convergence*, where they ideate on solutions to those problems, and *accommodation*, where they make ideas real to test how they might solve the issues at hand. In this practice, designers move through observation and experimentation, from abstraction to concrete experience. Depending on the context, there are tools that help designers enter these frames to accomplish desired goals, and they can be utilized in whatever order they see fit [7].

Recently, the fields of design practice aimed to address issues of social concern. Early in the construction of design as a field, Victor Papanek developed an argument of "socially conscious design." In his luminary book, Design for the Real World: Human Ecology and Social Change, Papanek states that "the genuine needs of man have often been neglected by the designer. The economic, psychological, spiritual, technological, and intellectual needs of a human being are usually more difficult and less profitable to satisfy than the carefully engineered and manipulated 'wants' inculcated by fad and fashion [8]." Over time, the fields began to listen and work to utilize their unique methods to address issues, such as ones dealing with international development and global poverty.

The first international event which catalyzed the interest in connecting these fields was the Ahmedabad Declaration in 1979, where the International Council of Societies of Industrial Design (ICSID, now the World Design Organization) and the United Nations Industrial Development Organization (UNIDO) held a congress with the mission of 'critical intervention with a social agenda.' Clarke's publication details the rise of anthropology in design practice during this age, and how the actions, topics, capabilities, and relationships of the profession were inextricably tied to the politics of the situated context [9]. More recently, the paper "Design Thinking for Social Innovation", associated with IDEO, an influential worldwide design thinking consultancy, made a case to turn the burgeoning field of design and innovation in a similar direction: towards addressing complex problems of a social nature, and adapting the methods of inspiration, ideation, and implementation to benefit the world [10]. Though IDEO has become one of the institutional flag-bearers for design thinking practice, the field has grown around the globe. These methods have been used in many different design contexts, towards an extensive collection of issues. In the field of public health, the company D-Rev has developed the Brilliance high-efficiency lamp, developed to treat the estimated six million infants with jaundice who are not receiving adequate treatment in their home communities [11]. In lighting and energy, the company D.Light [12] has developed solar-powered lighting solutions and have sold ten million solar light and power products in 62 countries, improving the lives of over 50 million people. In infant care, Embrace Global developed their now famous Infant Warmer, developed as a low-cost infant insulator disseminated to a reported 144,000 infants across the Global South [13]. Evidence of the interest of applying cross-disciplinary innovation to problems of global poverty is also growing. Organizations, such as the United Nations High Commissioner for Refugees, and the nonprofit design house IDEO.org, are using the design field and its methodologies to figure out how to best develop interventions for problematic contexts, including housing solutions for Ghanaian refugees, and climate change resilience alternatives for urban slum communities [14]. Universities, nonprofit organizations, businesses, government agencies, military organizations, and many more have begun to use the field to address a litany of complex problems. Recently, there have even been opportunities to send children to design thinking' summer camp [15].

It is in this context where I found myself, trying to learn how I can investigate spaces to research how design theory and practice interact with issues of global poverty and practice. I was introduced to the field by learning about the various Berkeley courses which taught design capstones in various international contexts, by learning about design thinking research in various laboratories, and by recognizing its spread into business, evaluation, social justice, public health, and other related fields on campus [16]. Towards this end, my master's thesis aimed to develop an understanding of what design can bring to popular issues of global poverty. The first section of the thesis reviewed the literature on the Bottom of the Pyramid movement over the decade it has

existed and made a case for human-centered design as a framework and collection of tools to help address the gaps in the field. The second section characterized elements of human-centered design competence of contributors to development-based design problems on OpenIDEO, an open innovation platform [17]. At this point, design thinking and related fields were treated by development professionals as a silver bullet to address issues of poverty. Its methods seemed applicable everywhere, across many disciplines, my geographic contexts, with a wide variety of stakeholders. It is understandable then that the field started to receive criticism.

One critical question asked was *how it is different* from other related methods. Depending on the people, the use, the culture, and the contexts, design thinking is very similar to human-centered design, co-design, participatory design, service design, human-computer interaction, participatory design, and many other related fields. Although this specific debate has many qualities, it aims to ask what the discipline is, that differentiates it from other approaches. As one of the many designers who seek to square this circle, I at present use an umbrella name to describe all activities, fields, and communities that purposively remake the world for the better: **innovation practice**. This moniker serves two immediate purposes: first, it is in my personal experience that 'practicing innovation' is an explanation that those outside the many fields of innovation and design better understand; second, by using innovation as a phrase, the many fields of design can interact with traditional fields of innovation, which includes but not limited to economics, organizations, entrepreneurship, social impact, evaluation, and international development. Henceforth in this dissertation, the umbrella field will be expressed as innovation practice.

Another critique is about whether the field *contributes positive outcomes* to the world. The ubiquitous use of the words 'design' and 'innovation' carries certain assumptions about our collective design practice; particularly, that designers are engaging in efforts that are positively directed and necessary, that the right people are engaging in design, and that the interventions will eventually lead to success given the correct implementation of said practices. However, this isn't always the case. Designs throughout history were proclaimed to be the satisfactory solutions to complex problems of global poverty, but upon further inspection afforded by the passage of time, we learned that designs had negative externalities including sustainability flaws, and user-product mismatch issues, which led to varying levels of design failure. Condemned examples in the recent past are well-known. One such example is the PlayPump [18], which theorized that children's playful labor could be used to pump water for villages, but its wide-scale rollout oversimplified the multiple water contexts in which it was deployed. Another example includes the One Laptop Per Child program, which theorized that giving each child a laptop would enable "collaborative, joyful, and self-empowered learning," but did not reportedly improve the math and language assessments scores of its intended community [19]. Are these examples failures of innovation practice, or innovation practice implemented in a failing manner? It is hard to say.

Other critiques of the field speak about how its spread has *increased the amateurization of design as a topic*. Nussbaum, who wrote an article called "Design Thinking is a Failed Experiment. So, What's Next?" made the case, among others, that companies who integrated design thinking into their activities turned the process "into a linear, gated, by-the-book methodology that delivered, at best, incremental change and innovation [20]." Another lecture, called "In Defense of Design Thinking, Which is Terrible," the speaker follows a thread of editorials that critique the field, speaks about how critiques about the fields' amateurization take into context how the profession has operated:

"We've talked for years about accreditation, the idea of licensing designers and regulating design. This would require designers to pass the equivalent of a bar exam in order to work professionally, thereby controlling the gates of who gets to practice design. Now when we listen to arguments like this...it's important to keep in mind how the business of design has traditionally worked. Put simply, there has long been an economic incentive for designers, especially in studios and agencies, to shroud design itself in secrecy, to obfuscate the particulars of its methods. Maybe even more so, there is an economic incentive to promote designers as "genius inventors," singular talents who are uniquely able to channel the spirits of "good" work—priests in the cathedral of design…. And yet design—and designers—seem perpetually threatened by democratization [21]."

This quote precisely gets at the core contribution of innovation practice as a field: **how it has spread**. Designerly ways of thinking are spread to 'nontraditional' practitioners, which leaves opportunity for nontraditional use cases and broad critique about its methodological dilution. These debates about what design is and how it contributes to the world are also deeply related to its novelty, its purpose, and how disconnected its practitioners are from each other. Practically, it meant many innovation practitioners I came across were in the same headspace as I was: stuck in the woods, using innovation practice like a hammer where every problem is a nail, looking for guidance. As an interdisciplinarian, this revealed an opportunity: if I could develop rigorous methods to straddle multiple disciplines, help develop theory about the evolving design world, and answer questions which reveal beneficial innovation practice, the whole community could benefit. Those opportunities eventually evolved into this dissertation.

Research in this subject is spread out across a wide variety of disciplines, in many separate contexts; in fact, depending upon the researcher's chosen boundaries for the field, any researcher that has developed, or studied, an intervention or process made to better the lives of the poor could arguably be included in this category. Research that focuses upon cross-disciplinary design practice, however, is sparse, due primarily to the precarious state of design for development's boundaries, among other reasons. There are gaps in understanding the current state of cross-disciplinary innovation practice, and if this practice is properly aligned with, and influences theory of 'good practice'. In this prospectus, I will outline research to investigate design practice for development towards this end.

What are the collective practices designers engage in, while developing technological interventions to address global poverty issues, and what cross-contextual tools can be developed to better align practice to design theory?

To investigate this broader question, I have developed three main categories of critique towards understanding design for development:

- What does the field of human-centered design for development look like, and how do the innovators practice "participation" with end beneficiaries?
- How do innovation actors evaluate their activities, and why are these approaches used in the Botswana innovation context?
- In what ways are national ethics institutions misaligned with design practice for development, and how can these issues be remedied?

This dissertation aims to answer these questions with an extreme variety of separate studies. You might ask, as a reader, how did such work turn into a systematic literature review, an ethnographic study of Botswana innovators, and a reflection on the gaps of research ethics institutions and their influence on designers? You would be correct in noticing that my path from project to project has been meandering. However, it fits the amorphous and evolving nature of innovation practice as a field. As a transdiscipline, innovation practice takes from any field, approach, or experience that tries to make novel interventions that benefit communities that matter (which is arguably, all of them), and can be usefully applied to 'wicked problems' of varied tastes and textures. Innovation practice is grappling with the nature of its emergence, the relationship it has with evaluating impact, and how ethics are involved. This dissertation, among many things, **aims not to develop laws of good or bad design, but to describe tools, lenses, and approaches that innovators can use in complex and adaptive environments to better our world.** Countless facilitators ask the question: "What methods, principles, and outcomes ensures innovation practice is successful? If after this dissertation, a reader hears such questions and answers, 'It depends on the context,' then I will have been successful.

The first study, a systematic literature review, aims to outline a collection of descriptive analyses of a community seeking to use design methods to address multifaceted global poverty issues. By developing a systematic literature review of researchers who publish peer-reviewed papers on human-centered design for development, this dissertation aims to survey the field and investigate the narratives for insights of how they practice design. As a complement to previous research on this literature dataset, this chapter makes two significant contributions: I outline the current research landscape using various metadata analyses including the researchers' locations, interests, and disciplines, and I also analyze the participatory nature of this researcher population. This review also reflects on the amorphous nature of design fields, whether we can learn from methods such as systematic literature reviews, and how we adapt and move forward as researchers.

The second study, by far the most extensive, is an ethnographic evaluation study of the evolving Botswana innovation community. With this work, I aim to weave a narrative about the issues, solutions, obstacles, history, and connectedness of prominent innovation institutions in the country, how they evaluate, and what influences these methods and worldviews. Two main categories of institutions are surveyed: the organizations at the national level, and a grassroots-led innovation network developed in the Kalahari Desert. The evaluation insights of these institutions are examined to see how innovation actors are aligned or misaligned, and what methods, approaches, and tools people can learn from each other. I also describe the activities and perceptions of these institutions in Botswana to further reveal insights about the Botswana culture as it is being made.

The final reflection is an inadvertent research insight I happened upon because of my difficulties with the previous study. While I tried to accomplish many goals as a designer, evaluation analyst, and development researcher in this dissertation, I gained the opportunity to investigate how these fields interact with issues of development ethics. My personal experience of conducting research in Botswana is a case study in how design and research practice are treated differently by ethics systems in the country, and developing institutions that support beneficial design activity is a difficult problem to solve. By investigating the systems of ethics support and by drawing upon fields of development ethics, I offer tangible ways to facilitate the development of development-centered ethics practice during innovation activities.

The potential benefits of engaging in such cross-disciplinary research are multifaceted: by evaluating our collective practices, we as a community can innovate better, can ensure our design practices match our reality, can empower our community members, and ultimately, can ensure that our design practices fall in line with our collective ethics. Moreover, understanding the current state of innovation practice is a critical first step in pushing the needle towards innovation empowerment for the global community. This research intends to do so, by supplying tools to support research and insight development about the impacts and practice of design thinking, and cross-disciplinary, inter-geographical insights about how design thinking interventions apply in real-life contexts in global poverty.

Synthesizing 1st and 3rd person: On Stories

Stories are how we understand and organize our lives. The history of stories is as deep as the history of the human condition, and we are exposed to them as early as we can understand them. We tell stories to understand morals, to talk with loved ones about our day, to work through our feelings, and to outline our goals. For most of my experiences during my academic training, I've taught, and understood, the importance of telling a logical, empathetic, critical, and useful stories that contribute knowledge.

One theme present in this dissertation **is how it uses and analyzes design narratives**. These stories come in different forms: they are stories researchers draft about how they interact with human-centered design, they are stories about what Botswana stakeholders want from the future, and some are my own personal stories about the obstacles I encountered, and how I turned obstacles into opportunities. They are systematically analyzed stories concerning the development of innovation and research, and they are stories about how communities integrate innovation into their communities. This dissertation will also be structured as a quasi-chronological story about how I came to answer the questions described here, and what the answers taught me about understanding innovation practice as a field.

This dissertation, aligned with an epistemological grounding in interpretivism, will weave my personal story with a broader narrative of how and why the topics mentioned should matter. It will contain background that informs the reader of both the gap in the fields, and my personal stories of navigating towards these research directions, research designs, and outcomes. Influenced by Wilson's luminary *Research is Ceremony*, the dissertation employs a pluralistic view on the importance of the personal and impersonal narratives in research [22]. As a result, this dissertation will drop in and out of the 1st and 3rd person; it will use autoethnography, and reflection, synergized with foundational research, interviews, content analysis, and focus group insights. This narrative style has deep traditions in design research; due to design theory's epistemological ground in anthropology, the personal experience becomes a useful method to unpack what happens during design projects when no other evidence is available for descriptive or inferential purposes. These stories also offer an explanation into how I personally arrived at the questions that cross such disciplinary expanses as capacity building, design thinking, developmental evaluation, social network analysis, participation ladders, development ethics, indigenous histories and values, policy planning, international surveying and metric use, national transitions, Botswana entrepreneurial culture, and other related fields.

I have taken exceptional care during the process to ensure that the personal insights I have come across as a researcher, though intentional in bias and positionality, do not cross into indefensible theorizing, and that my positionality is considered during the process to ensure that proper context is understood. However, as the epistemological need for the research evolves through the three projects, the personal voice will become stronger as personal reflection contributes more to the research methods, and leads into novel outcomes, useful insights, and potential future research. What ties all these projects together, however, is a sincere interest to describe certain qualities of development-centered innovation practice: how it is practiced, who considers it important and why, what use could come of it, and what must be contemplated to engage in the practice well. By applying the lens of the careful researcher, towards the tools and stories of innovation trailblazers, I hope this manuscript will be more than just of use – that it will catalyze change in yourself.

Chapter 2 | Innovation + Participation

"Can you tell me what is different about the field of human-centered design for development?"

- Berkeley Professor, at meeting for the Designated Emphasis for Development Engineering

Multidisciplinary Characterization: Finding Solid Ground in Innovation Practice

After I completed the publication that characterized design artifacts in development-centric projects on OpenIDEO, I strove to find new research that expanded my understanding of design as a field. In this process, I came across only a few other researchers who also tried to learn understand how far and deep design has spread. One resource, *Parts without a Whole*, the first large-sample survey of design thinking adoption in practice, showed a community of colleagues attacking the problem from a different angle. Funded by the Hasso Plattner Design Thinking research program, the same organization responsible for supporting Stanford's d.school, the study developed structured and semi-structured surveys with professional designers to see how design is actually practiced [23]. The study collected data from business professionals worldwide on how long they have personally practiced the field, which industries use it, how it enters organizations, what they think design thinking is, how the practice affects the working culture, and much more. I was ecstatic to learn I was asking the same questions as other esteemed design communities; it finally showed me I might be on the right track.

However, I noticed something interesting about the study, which tempered my enthusiasm: most of the design thinking organizations came from Germany, and overall from Europe, Middle East, and Africa, a few participants from America and less from the Asia-Pacific. Many of the organizations I had come across operated with a different geographic centrality (specifically, the Bay Area), and much of the development-centric work operated all over the world in countries with a wide variety of problems. At the same time, I found the designers the study mentioned as the foundations of design practice; namely, IDEO, Martin, Schon, Simon, and Buchanan, were then unfamiliar to me. I realized my knowledge of innovation only reached the tip of the innovation iceberg. If this study topic didn't represent the 'full' field of designers and drew upon intellectual heavyweights in design for social impact, like Papanek and Manzini, how could I trust the outcomes? These questions are why I proposed to my design group how necessary it was to do a study like this of our own; aiming to draw boundaries around, and learn about, the collective experience of a design thinking method. As designers are influenced by, and practice, methods which seek depth of understanding in specific contexts, there was no single study which aimed to understand what designers are doing across many separate contexts when they say they are practicing a design method. Many single case studies existed, and multi-site studies as well, but a broad survey remained a gap. To fill this gap, we needed to leverage a collection of curated, diverse, representational design stories which itself represented how design has spread. I realized the best opportunity to analyze design stories would be to develop a systematic literature review of design practice.

This chapter of the dissertation will describe the methods, and outcomes, of multiple studies investigating a systematic literature review of Human Centered Design for Development (HCD+D). In this study, I outline past research conducted in the design team that applies various lenses to the same dataset, and further describes the design population, interest, and activities. The subsequent three sections were a joint effort with doctoral students Julia Kramer and George Moore, and undergraduate researchers Wendie Yeung and Nancy Li. I took the lead on the "Methodology of HCD+D Data Collection" components; Julia Kramer was the lead on HCD+D: Who, When, What, and How; and Nancy Li was the lead on the Co-Author Social Network Analysis.

Secondly, I apply a new lens not present in previous research to the dataset: how the researcher-designers describe the participation of aligned stakeholders in the design process. The purpose of this chapter is to *expand understanding of innovation practice by applying standard design values lenses to a population of design narratives*, to understand the complex outcomes and activities that might arise when aiming to design. I include summaries work done by my research colleagues in an effort to show how our many analyses can be understood together to characterize the field of human-centered design for development. For a fuller version of the Who, When, What, and How analyses and the Co-Author Social Network Analysis, I direct readers to the original publications referenced here. Finally, I reflect on the insights from these methods, how they apply to other related fields of design, and how to move forward with the insights.

Methodology of HCD+D Data Collection

To start such a literature review, we must first circumscribe boundaries: a systematic method to include and exclude publications. In this, however, lies the first challenge. There are many different terms that describe types of innovation practice, each with their own culture, community – and more practically, with different outcomes should they be searched on any search engine. Practically, the search words we use will determine the fields that should be included in this systematic introductory study. If the boundaries are drawn too small, e.g., we use too few words, the study leaves out fields that could represent the breadth and variety of the field's current use. If the boundaries are too large, e.g., we include too many, analyzing the dataset manually becomes a logistical nightmare. We decided to use a practical, yet circumscribed, method that focuses on published papers: keyword searching over Google Scholar. Google Scholar is globally available and presents results in a variety of journals, conferences, and other publication outlets. Performing a keyword search of 'human-centered design' on Google Scholar, therefore, gives us an expansive set of papers that mention the words 'human-centered design' in various journals, backgrounds, and communities. We chose to focus on HCD because of its current traction as a leading methodology in design-for-development work. In 2008, the Gates Foundation tasked IDEO to create the Human-Centered Design Toolkit [10], and it is through this document that human-centered design has gained major traction as a design approach for social impact, as is visible by its mention in many of the review papers' contents.

Each cut was done by manually reading each document to determine if it fit the boundaries we set. Adding further design keywords would have massively increased the dataset size, and the time to develop useful analyses. We acknowledge there are many other possible systemization paths, and there might be a different method to circumscribe unknown design literature. Such is the complex experience of circumscribing an evolving field, and why a 'systematic' review is such a tricky endeavor. However, we contend that our choice to use a single design-based keyword allows us to develop the boundary we intend for our search. By using HCD as the anchor, instead of including other design keywords, we purposefully focus our search on the set of papers that explicitly use HCD. This paper discerns specifically how HCD-influenced researchers use the term for their own ends, as members of the growing field of practice. We posit that the researchers who use these indicators do so purposefully to draw upon the approaches, mindsets, and resources that have arisen over the recent years. This paper is an effort, and we welcome further researchers who aim to investigate how others have adopted, critiqued, or modified the language of HCD for development. By examining the qualities of this HCD sector of the design world, we can gain insights into how to examine the other subfields of innovation practice.

To begin our literature review, we first developed a list of keywords that would comprehensively cover the set of academic publications related to HCD+D. Based on a survey of keywords in the literature, we constructed a list of 13 keyword pairs: "human-centered design" conjoined separately with 'developing countries', 'developing economies', 'developing world', 'global development', 'global inequality', 'global poverty', 'international development', 'low-income', 'low-resource', 'poverty', 'resource-limited', and 'third world'.

We input these keywords into the Publish or Perish software program, which allows a user to input keywords and searches the Google Scholar database to output the corresponding list of papers that contain these keywords [24]. After deselecting all papers that we considered to be non-representative of our intended analysis, our dataset included only archival peer-reviewed papers written in English that described practical examples of researchers engaging in an HCD+D approach. The output also includes various metadata for each article, including the paper's author(s), the year of publication, and the citation count of each paper. Overall, we compiled a set of 1,441 papers, which we then systematically deselected those that were not representative of our intended analysis. We show these deselections in Table 1.

Table 1: Filters used to systematically deselect papers from the dataset [26]

	Description	Number of Papers Remaining
Initial List	Pulled from Google Scholar using sets of keywords	1,441
Deselection Round 1	Deselect papers that were cited 0 times, if published before 2014	877
Deselection Round 2	Deselect books	760
Deselection Round 3	Deselect: · Papers that were not actually about HCD+D · Papers that were not available in English · Papers that were not accessible online or in the University of California Berkeley library system	282
Deselection Round 4	Deselect: · Papers that were not classified as a case study or experiment · Papers that did not list a research site · Papers that were not peer-reviewed (e.g., undergraduate theses, master's theses, PhD dissertations, and policy briefs)	128
Deselection Round 5	Deselect papers where the authors were not actually engaging in design practice (i.e., papers where the authors research was about design without designing anything)	83

Deselection Round 1: We only included those papers that have had some quantifiable impact on the research community. Therefore, we chose to exclude papers that were cited zero times. We did, however, keep papers that were cited zero times if they were published in or after 2014, because we did not feel that these papers had enough time to be found and cited between their publication and our data collection in early 2015.

Deselection Round 2: We focused only on papers about HCD+D. We felt there were more commonalities among papers than there were between papers and books. Furthermore, an initial exploration of the books in the dataset showed that there was a vast range between the degree where HCD+D is a focus, from fully integrated to mentioning the field in passing. We leave a book analysis for future research endeavors.

Deselection Round 3: We wanted only to include papers that were explicitly engaged in HCD+D, including those that involved in foreign and domestic countries. Therefore, we kept only those papers that included:

- Work with a community experiencing a form of multidimensional poverty,
- Work with a community experiencing "institutional voids," or the absence of supportive intermediary institutions like credit card companies [25], and
- Work with a community experiencing a loss of freedom or capabilities.

In this cut, we also excluded papers that were not available in English, due primarily to our lack of proficiency in other languages. We also excluded papers not accessible online or in the University of California Berkeley library system, as they might not be available to other researchers as well.

Deselection Round 4: We only included papers that discussed practical engagement with end users. We felt that only the papers classified as experiments or case studies (as opposed to, for example, a theory paper) could not defensibly contain research engaged with end users. Therefore, we cut out papers that were not experiments or case studies. We also excluded papers that were not peer-reviewed to ensure that the papers in our dataset were pursuing specific research questions with defensible rigor.

Deselection Round 5: We only included papers where the authors themselves were conducting the design practice. Therefore, we did not include papers where the authors discuss the design approach that other designers took (e.g., a professor writing about the experiences of student designers).

This final dataset had multiple forms of metadata that were eventually used in the collection of analyses: the number of citations up to the point of collection, the title of the publication, its hyperlink, the authors' names, the year of publication, the source of publication, the institution where it was published, the region or city where it was published, the Google Scholar Rank which designates in what order Google Scholar returned the results, the date when this data was queried, the keyword sets under which this paper was found, and the actual content of the paper. The full set of 83 papers is available at tinyurl.com/HCD-D-publications. With this dataset, we had the opportunity to analyze the papers in a litany of ways. Those analyses are below.

Previous Data Analysis Methods of HCD+D Dataset

The research team brainstormed various questions that examined pressing design principles of these researcher-designers of the dataset and their work, so we could investigate this collection of data in as many useful ways as possible. One of the early contributions was broadly describing qualities of the dataset, to add to the collective knowledge about the recent history, disciplinary and geographic boundaries, participants, and activities of design practice for international development in research intrigued the research team. Towards this end, we asked of the dataset: who is practicing the work, what goals are they trying to accomplish in which fields, when they made their contribution, and where they find themselves. The full analysis and methods are available in the working paper, or which I was lead author of the collaboration [26].

HCD+D: Who

To answer the question of who is researching in HCD+D, we used frequency counts of the number of authors who published papers in the dataset. We counted the unique authors, which authors published multiple papers, and if there were relationships between who published, where they published, and what they published about.

HCD+D: What

We used a closed-coding system to classify each paper's designated area of interest. In this approach, we collected and clustered the various focus areas covered by the papers. We considered the goals and areas of four organizations and initiatives: The United States Agency for International Development (USAID) [27], the United Kingdom's Department for International Development (DFID) [28], the Sustainable Development Goals (SDG) proposed in 2015 by the United Nations [29], and the Millennium Development Goals (MDG) proposed in 2000 by the United Nations [30]. We then consolidated the goals and/or topic areas of these projects, which are listed as poverty and inequality; hunger and food security; water and sanitation; global partnership and cooperation; education; global health; economic inclusion; gender equality; governance, human rights, and conflict; environmental sustainability; and inclusive infrastructure. We applied this list of eleven focus areas to the dataset by classifying each paper in the dataset according to their focus area(s). We then counted the frequencies of papers in each of the focus areas.

HCD+D: When

To answer the question of when HCD+D research is occurring, we counted how many papers were published each of the years we collected data. We then investigated various patterns of these papers, such as determining the level of growth of the field, and if when people published was related to where they published and the topics they published about.

HCD+D: Where

As development-centric designers, we found this lens of analysis to be particularly useful. The concept of "Remote Design" was discussed in the paper Design for Development: Three Questions, where the authors spoke about their concern for many designers that are culturally, geographically, and institutionally separate from the communities that they aim to impact. This, therefore, limits their ability to engage in design that actually helps the communities they purport to serve [31]. Though this dataset, we had an opportunity to investigate where authors investigate, and the institutions from where they hail, which can lead to empirical data about the prevalence of this phenomenon.

To answer the question of where HCD+D research is occurring, we coded three categories: the country where the first author's host institution is located, the country where the rest of the author's host institution is located, and the country where the authors were located at the time of publication. We then counted the frequencies of the country. Additionally, influenced by the capacity of geographic information systems to analyze and visualize many types of data, we provided visualizations along each of these dimensions across the world through simple choropleths, using QGIS, an open-source geographic information system software. By comparing the location of the publishing authors with the location of their chosen countries to conduct research, we can ascertain the distance between those who direct HCD+D projects and potential end beneficiaries. Which countries are engaging most heavily in HCD+D? Which countries are not engaging at all? Where do certain countries decide to engage in research? Where are the targets of such research located?

We developed filters to give us insights into country-specific research. For example, one might ask where do authors from the United States engage in design research, or conversely, from where do authors who research in India hail? These choropleths also give us another opportunity to map all collected metadata (time, impact, researcher involvement, etc.) by location as well. An example graph that shows where researchers from developing countries conducted their research, is available in Figure 3.

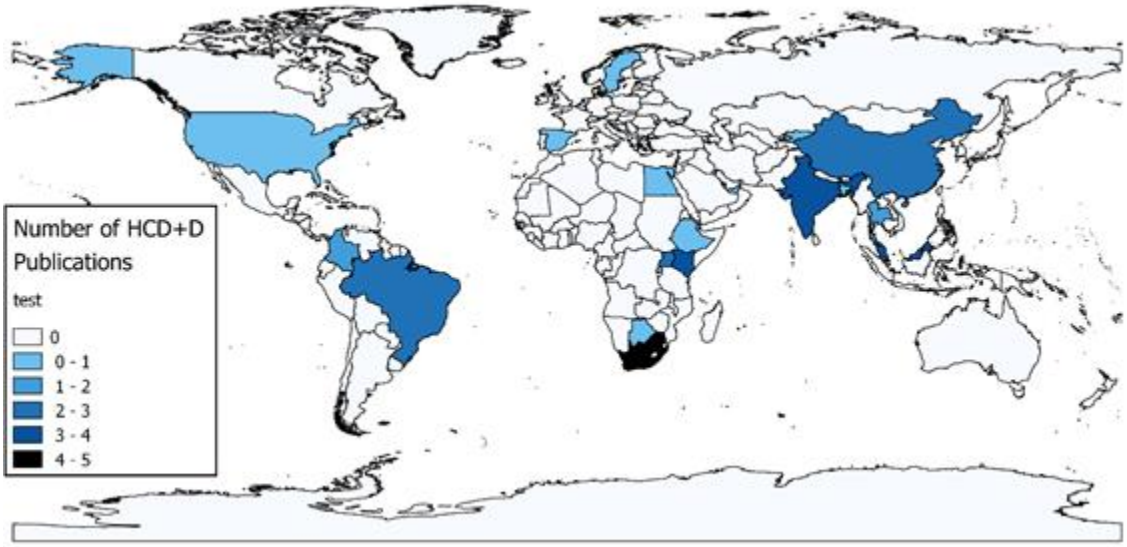


Figure 3: Choropleth where researchers from developing countries conducted research [26].

Insights

Through the research, we found a litany of interesting insights. Inclusive infrastructure and global health were the foci mentioned the most, and gender equality was not a specific focus area in any of the HCD+D papers. For instance, the first HCD+D papers were published only 12 years ago in 2004. 2009 saw the first spike in interest and, since then, the authors published between six and twenty papers in the field each year. The largest set of papers (20) was in the last full year of our study 2014, and this upward trend is likely to continue, given the continued increase in HCD+D interest across universities and industries. Information and communication technologies (ICTs) comprise a significant portion of all the inclusive infrastructure projects. The other categories have not increased at nearly the same rate. HCD+D and a clear majority of the authors have not published before their contributions in the discourse. Only 48 countries represent the current landscape, which is less than a quarter of the countries in the world [32]. Moreover, we note a burgeoning interest in geographically broadening HCD+D practice across the globe. Most of the research is coming from the United States (145 author mentions) and the set of authors come from only 37 countries. However, we also note an increase in researchers from Non-Western countries; particularly, South Africa, India, Kenya, Brazil, and China. We also observe most of the research studies and is conducted in the United States, with thirteen papers mentioning the country as a research site. The United states also has the most diverse places where it conducts research, has the most authors, and has the most research conducted within its borders. We also note that most of the community members who research across country lines are from western countries, such as North America, Europe, and Australia. As the field grew in popularity over the years, where the authors come from, what they study, and the topic they aim to address all become more diverse.

The findings give pause to the notion that HCD+D is currently a globally interconnected field. Near the end of the dataset, authors still mainly practice HCD+D in a small number of countries around the world. Going forward, HCD+D must encourage, support, and fund the practice of this design practice around the world to foster a more representative community. The research conducted in this manuscript contributed to a broader understanding of what the current landscape of research in human-centered design for development. We hope however, that these trends towards further diversity of HCD+D use will continue over the coming years. Each of these conclusions points to the areas where the HCD+D field can improve in the future. Future researchers are encouraged to leverage these conclusions as starting points for further investigation.

Co-Author Social Network Analysis

Another lens of analysis applied to this data set was to learn about how those in the system collaborate with each other. As is established in ISO 9241-210, good human-centered design teams include multidisciplinary skills and perspectives [34]. Moreover, In Beaver's "Reflections on scientific collaboration (and its study): past, present, and future," he notes many reasons why people collaborate, including "access to expertise and resources, improved efficiency and productivity, decreasing one's feelings of isolation, and advancing knowledge and learning." Also important in this context is how the author also states that "physical location is no longer a barrier to the free and easy exchange of information [35]." In the growing field of human-centered design, we had the opportunity to investigate if these communities have developed productive relationships with each other [33]. To support this need, Li, Kramer, and I developed a co-author network analysis of the dataset to understand how these researcher-designers connect to each other

[33]. Co-authorships represent a direct and visible mark of collaboration between two or more authors; although other forms of collaboration are possible, intentionally starting with the established and available metric of published collaborations is a benchmark from where other collaboration studies can build. The analysis collected quantitative metrics about the description of the network, including measuring:

- the density, which measures the cohesion of the network,
- clustering coefficient, which tells us the tendency of authors to collaborate with each other,
- The network diameter and the size of the largest connected component give us a sense of the longest path in the network – showing how quickly authors can communicate with each other through their links – and the biggest group of collaborators,
- betweenness centrality, which indicates the number of times an author is located between any two other authors in the network on the shortest path; authors with high betweenness are good connectors,
- closeness centrality, which measures the average length of the shortest paths between an individual author and all other authors, and
- authors who are "cut-points", who are part of a connected community such that their removal causes the community to become disconnected.

These insights were also collected by my research collaborators over the years of publication, to develop a proxy for how the network has evolved since 2004. Each node is a unique author, and the edges between the nodes represent a co-authorship relationship. A figure of the final network analysis of the dataset is available in Figure 4.

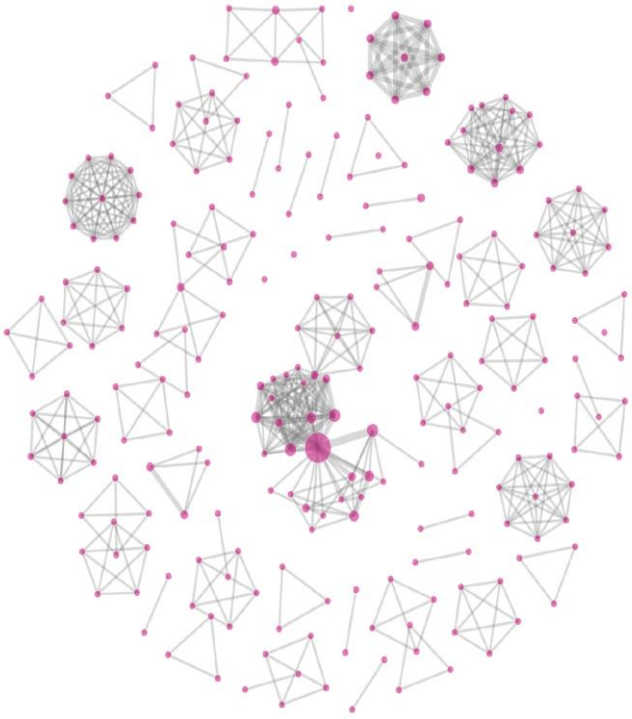


Figure 4: HCD+D network of authors who published between 2004 and 2014 [33].

There were a wide variety of insights in the data about how people are connected. Analysis of the network using Python's NetworkX library showed that the community is tight-knit. A clustering coefficient of 0.82 indicates that authors have a high willingness to cooperate with other authors in the network. A review of the lineage of co-authors in our data set does reveal close ties between many of the co-authors in the network.

However, the HCD+D network is low density, and only 1.8% of the total possible number of relationships were actualized by 2014. The high clustering coefficient and low density infer that the communities rarely develop publications relationships with the rest of the community, even though the community gets larger over time. This is possibly due to the disciplinary clusters of co-authors, and how there is little incentive to collaborate in such an intensive matter as co-authoring a paper. It seems that the HCD+D community in comparison is highly fragmented, with many pairs of authors not connected to the rest of the network, and that most authors lie on the periphery of the network. Only a few prominent authors with high closeness are strategically placed at central positions within the network, from which they can disseminate information quickly throughout the network. The full methods, insights, and data analysis are available in the published paper [33].

Methods Analysis

Our research groups also used the content of the paper as another useful source of data for this review. Although these papers are developed as research publications, in this context they serve a separate purpose: a collection of research narratives about their design activity: their purpose, their process, the communities they worked with, and their outcomes. The team also answered critical questions that investigate how people design using the content, as described below.

A colleague in the group, Julia Kramer, analyzed the content of the papers to determine the design methods that were documented as being used. Beckman and Barry's innovation model, which offers design as a collection of learning processes that observes design contexts, developed frameworks around the collective insights, generates ideas to address the issues, and experiments with the solutions, was offered as a conceptual framework for organizing the methods from the papers [36]. In the papers, 119 unique methods were mentioned, of which the interviews, surveys, and observations were the three sequentially most mentioned methods. The analysis also counted the methods that were only mentioned, which were actually conducted by the authors, whether there were any new methods mentioned by the datasets, and whether a specific pre-defined methodology was used to support the research. Figure 5 shows world clouds of the various methods used, where a larger font size represents more times the method was used. The more in-depth methodological analyses of the paper are available in the thesis [36].

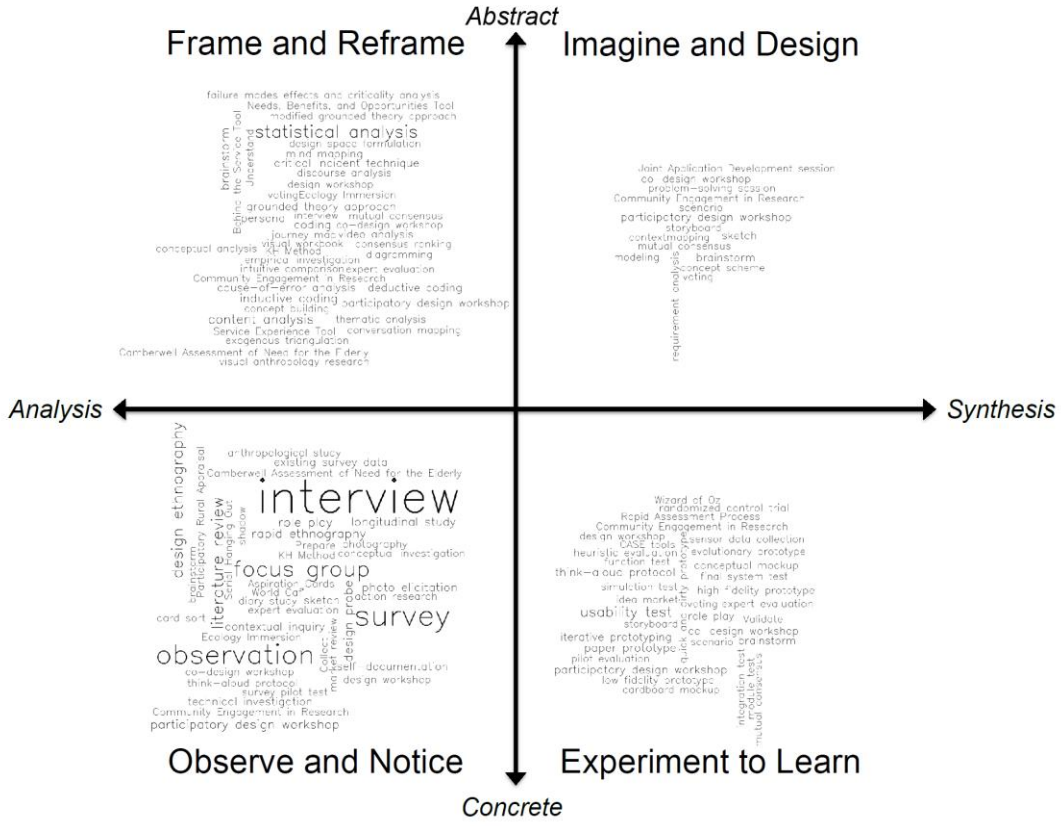


Figure 5: All methods mentioned in dataset papers, separated by design process phase [36].

How HCD+D Participates

There is yet one final analysis that the research group applied to the HCD+D content dataset concerning their design activity: how the communities participate with stakeholders in their respective projects. This was initially inspired, again, by ISO 9241-210: Ergonomics of human-system interaction -- Part 210: Human-centered design for interactive systems, which mentions in its principles that "users are involved through design and development…. User involvement should be active by...Participating in design, acting as a source of relevant data, or Evaluating solutions [34]." I describe the methods and outcomes of the research below.

The concept of participation is not new to the fields of design, development, nor research. In design, the history ranges back to the 1970s in Scandinavian countries where multiple data-processing' technologies implemented designed to automate work, de-skill manufacturing floor technologies, lower wages, and give workers less power over their working conditions [37]. However, due to unique Scandinavian legislation and workplace agreements, there was political motivation to develop projects that address how to address these machines that disempowered workers. The research projects that followed evolved eventually into an entire field, which currently operates under the broad field of participatory design. In international development, the initial global push towards participation is in the growth of Participatory Rural Appraisal (PRA). Called "an approach and methods for learning about rural life and conditions *from, with and by* rural people," it draws from sources in activist participatory research, agroecosystem analysis,

applied anthropology, and field research on farming systems [38]. In the late 80s, there were parallel developments in Kenya and India where communities and non-government organizations spread the utility of including villagers and other volunteers in the design and implementation of their resource and development interventions. In many ways a South-South innovation, PRA methods were shared across the world through organizations in Botswana, China, Ethiopia, Ghana, India, Indonesia, Namibia, Nepal, the Philippines, South Africa, Tanzania, Uganda, Vietnam, Zambia, Zimbabwe and several countries in francophone West Africa. In research, the fields of Participatory Action Research (PAR) and Community-Based Participatory Research (CBPR) align research with procedural justice to enact social change. Evidence demonstrates how these methodologies can not only elicit exceptional research practice and outcomes but also to increases the capacity of the marginalized to be empowered towards their interests – even after the research project is completed [38].

Whether participation should be a critical value in the design of interventions is a debate that has lasted as long as these disciplines. Each of these topics has been heavily critiqued. As was expressed in Staton, Kramer, Valdez and my contribution, From the Technical to the Political: Democratizing Design Thinking [40]:

- Published critiques touch on the difficulty in executing participatory design for all but small-scale projects,
- Methodologically, participatory design hinges on an outside designer initiating and likely leading the design process,
- The users are not afforded the agency to choose when to be involved in such a design process; they are free to opt out, but they are not free to opt in,
- PRAs in practice are critiqued for the prevalence of officializing and muting practices that silence and exclude non-dominant communities that could otherwise contribute to more nuanced understandings and design solutions of PRA initiatives,
- The logistical difficulty of coordinated, wide-scale involvement of development actors necessitated by the methods and requirements of participatory inclusion can consume capacity necessary for other development tasks and priorities, and
- Participatory processes generally require additional time and resources to develop collaborative capacity and genuine partnership between communities and "expert" outsiders. Partnership investment must be balanced with practical budget concerns and sensitive political timelines.

By asking how researchers worldwide grapple with development problems, new insights might garner *more understanding about the complexities of participation* – what themes arise, what makes the practice difficult, who is involved in the participation, and if participation is even a useful lens to the HCD+D community in the first place. To this end, we ask the question as follows:

In what ways do the innovation authors allow design decisions by other stakeholders during design of projects?

How do we categorize the levels of participation? We applied a participation ladder framework, adopted from the framework developed by Harder et al. to the content in each of the case studies in the dataset [41]. We establish the 'level' of participation by categorizing the base amount of author-described participation by the end user in decision-making during the design of the interventions. In these papers, the researcher-designers who wrote the papers had the most power in how the design story was told; therefore, the level of participation of all other stakeholders are proxied by their distance from these authors. There might be other research or design professionals who partnered with the paper authors who have more power, who are professionally adept, and critical members of the design team although they are excluded from the being an author of the story. However, as those people are not authors of design narratives present in these journal articles, we use authorship as a proxy for design power. With these methods, we gain an opportunity to see the types of members the authors believe should have power over the design process. This gave us a chance to investigate more deeply the types of stakeholders the authors consider worthy to design. Unless it was specifically otherwise depicted in the text, we practically assumed that only authors synthesized, used, and made decisions about the information from other stakeholders, which is not evidence of true participation. Even if other types of participation did occur and they aren't written about in the papers, the fact that the authors excluded those activities from the narrative shows how much, or how little, they prioritized participation in the first place.

The first category is 'Design For', which means the researcher-designers designed 'for' the end user. This label means that in the paper, there was no evidence that anyone outside of the authors of the paper made design decisions. It should be mentioned that is a higher, and a qualitatively different bar, than solely acquiring information from other stakeholders; we must see evidence that although outside stakeholders were consulted, they had no opportunity to make design decisions. A total of 53% of the 83 HCD papers recorded here were 'Design For'. The next level of participation is labeled 'Design With,' meaning the researcher-designers engaged in a process alongside 'with' other members of their design workshop. This means that at any time during the design process, the papers show evidence that someone other than the paper authors contributed to design decisions. Twenty-four articles, or 28.9%, engaged in some form of 'Design With'. The next level of participation is labeled 'Design By'. This means that at any time during the process, the papers show evidence that the paper authors ceded power, and other authors were recorded making design decisions on behalf of the projects. Fifteen studies, or 18.1% of the studies, were 'Design By'.

We also noted in the analysis that there were a wide variety of different stakeholders included in these case studies and took note of studies which included the **intended end user of the created technologies as a direct contributor to design decisions**. Therefore, for the 'Design With' and 'Design By' categories, we added an extra marker to indicate if some of the design ever occurred with end users. Nine of the papers were 'Design With End User', which means the end user was somehow involved, but did not take over the design process for themselves. 'Design With End User' papers comprised 10% of the entire dataset, and 36% of all 'Design With' papers. Eleven of the papers were 'Design By End User', which means the end user held more sway over the design process than the designer-researchers at some point in design process. 'Design By End User' papers comprised 13% of the whole dataset, and interestingly, 73% of the whole 'Design By' category. This indicates when these authors do 'Design By', there might be a relationship between end user involvement, and the amount of design power leveraged to those users.

In the dataset, we collected a list of the different types of stakeholders who were mentioned in the paper development. We categorized the stakeholders in two ways: we listed every stakeholder mentioned in the case studies, and we also found and listed the intended end user of each of the studies. They are listed below, in Table 2.

Table 2: End Users in studies.

Design For
users that participate in the subsidy program of the centers for either Internet access or computer training
ecommerce users in South Africa
English speaking people 65 years or older that take at least three prescription medications (1 of which for a chronic medical condition)
HCI Practitioners
patient users of eHealth tools in the Southeast Mediterranean region
citizens of Kyrgyzstan
students of online courses
rural communities in Mongolia (eligible to receive health care)
cancer patients receiving radiotherapy treatments in NUS
mobile phone users in rural Uganda
elderly people in Japan
internet users in Central Asia (Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan)
NUTES health center
midwives in Uganda
internet users (and non-users) in Kyrgyzstan
Students from Muslim e-commerce users
HCI reflective practitioners and researchers
users of e-commerce websites in Pakistan and Australia
telehealth users in Brazil
rural Indian farmers
semi-literate and illiterate Farmers in India
citizens of the United Kingdom, India, and Brazil
nurses employed by government in rural Kenya
Sri Lankan Farmers
Malaysian HCI practitioners
social media and technology users in China
California Central Valley Community
rural clinicians (nurses and clinical officers) in western Kenya
emergency response teams (citizens of one of the "least prosperous" Emirates in the UAE)
midwives in Uganda
internet users in Uzbekistan, Kyrgyzstan, and Kazakhstan

	engineers
	Thai healthcare users, purchasers, designers, and manufacturers
	product designers
	rural farmers in developing countries
	low-income youth in China
	low socioeconomic status (SES) adults in South Central Appalachia
	elderly (approximately 58 – 72) users of technology
	ASHAs (Accredited Social Health Activists)
	clinicians in rural Nigeria
	citizens of emerging markets
	first year students at University of Namibia
	nurses in rural western Kenya
Design With	
	community-dwelling people with dementia
	Citizens from Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan ages 15 and older
	patients (and their families) of medical facilities in developing regions
	midwives
	oral, rural users
	male employees working in metal autoparts factories
	ME 310 students at Stanford
	Health workers, supervisors, NGOs, and MOH Officials
	a target local community (crisis victims)
	people on welfare
	people that live in Cambodia; (Rural cambodian households; private sector suppliers)
	mothers and fathers contemplating contraceptive treatments
	child bearing women in South Africa
	midwives in Uganda
	clinicians in Kenya
	rural businesswomen and small farmers and artisanal miners in Southeast DR Congo
Design With: Including End User	
	Chinese and Swedish drivers
	Spanish and English speaking farmworker communities in Earlimart, California
	marginal farmers in India; scientists
	students involved in Innovation workshop
	citizens of rural Malawi
	illiterate children in Pakistan
	children in rural India
	clinicians in India
	first-time smart phone users in Iran and Turkey
Design By	

	poor communities in Bangladesh (Goalmari arsenic poisoned well)
	consumers with broken devices
	Alameda county children
	electrical energy consumers in rural Kenya
Design By: Including End User	
	a deaf patient in South Africa (and/or) Pharmacists that interact/provide for Deaf patients in South Africa
	deaf people in a developing region
	people that use online chats and forums in central Asia
	Atlanta community
	Iranian users of mobile communication devices
	cooperative of weavers in a rural village in Rwanda
	textile weavers
	Egyptian citizens with a special emphasis on the illiterates and low-literate citizens living in rural areas
	Migrant workers in China
	farmers in South Africa
	African American community near Atlanta

There is a wide variety of the type of stakeholders that exist, and yet, there is no discernible qualitative difference between the types of users who are a part of more participatory projects, and those who are not. A critical point of mention is that this study is inherently biased towards stakeholders the researchers considered important enough to state. Some research projects fail to consider the presence of 'downstream' actors, e.g., actors close in geography, function, or proximity to those being affected by the problem space, much less how they contribute. Those stakeholders directly listed in the papers are in Table 3 below.

Table 3: Stakeholder list for each study.

Design For	
	employees (managers) of local eCenters (and business partners that hosted them) in Kyrgyzstan; clients of local eCenters in Kyrgyzstan, local businesses partners that might interact with telecenters in Kyrgyzstan; local researchers; USAID representatives; Kyrgyztelecom; CIIP
	ecommerce users in South Africa; companies that host ecommerce sites; expert reviewers
	caregivers of these people (adult family caregivers); doctors; pharmacists; Colorado review board; nurses
	MCMC; government agencies; interviewees; MAMPU
	health care providers and personnel; local physicians
	researchers from UW; members of CAICT
	University of Botswana
	Asian Development Bank (ADB); International Research Development Council (IRDC); health care professionals; workers in Mongolia; mothers and young children in Mongolia

Norrlands University Hospital (NUS); cancer patient caretakers at NUS; cancer patient family members; dose planning nurses; doctor; staff members; oncologist; radiologist
FINCA's lead field agent in Victoria Basin; manager/field agent for Victoria Basin Micro-Finance Cooperative; MTN; Zain; bank representatives
mobile phone providers in Japan
Central Asian Information and Communication Technology (CAICT) project partners; BRiF research group; University of Washington
International Cartographic Association Commission on Visualizations and Virtual Environment (ICACVVE); NUTES health center; cancer researchers; policy makers; program mangers; epidemiologist; consumer groups
Ernest Cook Ultrasound Research and Education Institute (ECUREI); University of Washington (UW); midwives in Uganda; Portable Maternal Ultrasound Initiative; women with high risk obstetrical; radiologist; sonographers; radiology residents; nursing and mid wifery educators; maternal and child health advocates; a traditional birth attendant; 52 rural mothers
CAiCT; BRiF; UW; Kyrgyzstan telecom; Elcat Asia
e-commerce websites
HCI reflective practitioners [24] and researchers
B2C e-commerce websites in Pakistan and Australia; doctoral student from UTS; online shopping managers; business firm representatives
NUTES Telehealth center at Federal University of Pernambuco, Recife, Brazil; administrator; Computer system analyst; health informatics researcher; health professional; project manager; statistician; UTS review board
None
local agricultural experts; local agro-based markets; agricultural experts; local shop keepers; government; fellow interface designers
translators; local government
Academic Partnership Providing Access to Healthcare (AMPATH); physicians; nurses; government of Kenya
The Social Life Networks for the Middle of the Pyramid (SLN4MoP) researchers; Sinhalese; Tamil
CEO's; managers; project leaders; IT sales and marketing; senior analyst; system analyst; programmer; executives
Chinese designers; parsons the new school for design in NY; Tsing Hua University; taxi drivers
LBS programmers; nonprofit staff members; Central Valley Partnership; Civic Action Network; UC Berkeley faculty and graduate students
Academic Model Providing Access to Healthcare (AMPATH); Icahn School of Medicine at Mount Sinai (New York) and Moi University College of Health Sciences (Kenya) review boards; Moi Teaching and Referral Hospital; Government of Kenya; North American universities and medical centers; Kenyan Ministry and Health facilities; physicians; government of Kenya
local police department; dispatcher; emergency patrol; responders; call-takers; World Health Organizations; CCR; officer; public safety agencies
pregnant women in Uganda; University of Washington Radiology Department; radiologists and sonographers in the United States; midwives; 4 physicians; husbands; clinical officers; patients; mother-in-law; neonates
Central Asia + Information and Communication Technology (CAICT) project; managers at local NGO internet access points; local researchers; 4 US researchers; 3 Kyrgyzstan researchers; Family and youth in the capital city of Bishkek, Kyrgyzstan; interpreters

	resource-poor individuals in developing countries; Student group; NGO fixated on water issues; Water purification experts; residents of Visakhapatnam; Visitors; Women; Husbands; Men who fish; foreigners; Group of children; lower caste people; broom maker (skilled); women who wash clothes; Puno (peru residents)
	Medical Devices Laboratory (MDL) of the National Metal and Materials Technology Center (MTEC); National Science and Technology Agency (NSTDA); Thai industries; healthcare practitioners at Thammasat University Hospital; Nurses and nurse assistants (healthcare users); Deputy Director of the Sirindhorn National Medical Rehabilitation Center (SNMRC) or (purchaser); Assistive Technology Center (ASTEC); Healthy Ageing Research Program (HARP); Chulalong University; the Human Centered Design Laboratory, King Mongkut's University of Technology; manufacturers
	students; China Institute of Technology; Tama Art University; Children; Parents
	farmers; information service workers; agricultural development agents; agricultural experts; farm input supplier; credit agents; regional office; extension agents
	Landlord
	Literacy Volunteers of the New River Valley (LVNRV) community engagement specialists; adults; janitorial workers; housekeepers
	elderly from age 58 – 73
	(Accredited Social Health Activist (ASHA); SEWA Rural; clients: pregnant women; mothers of infants; new born babies; children under the age of 2
	clinicians in rural areas of Nigeria; clinicians in the UK; patients; multi-disciplinary team (MDT)
	researchers; designers; South Africans; Rwandese; Kenyans; Ugandans; Indonesians
	University of Namibia; Extended Study Unit (ESU) at Rhodes University; tutors; lecturers; faculty; mathematics lecturers
	Icahn School of Medicine at Mount Sinai review board; Moi University College of Health Sciences review board; Academic Modeling Providing Access to Healthcare (AMPATH); rural clinicians; physicians; patient rural clinicians; nurses; clinical officers; AMPATH Informatics team; Clinical mentors'; program managers; mobile health developers
Design With	
	people with dementia; informal caregivers; professional caregivers
	Citizens from Kazakhstan; Kyrgyzstan; Tajikistan; and Uzbekistan ages 15 and older
	MedCo; medical device manufacturers that provide for developing communities; patients and their families; medical personnel
	SonoSite; GE; Siemens; Philips (companies exploring portable ultrasound in developing communities); University of Washington; indigenous midwives; radiologist; ugandan obstetrician leaders; researchers at UW; instructors; ultrasound clinicians; medical and grad student; seattle midwives; pregnant women in developing communities
	village chief; representatives of the "Literacy Bridge" company; farmers; local staff
	management in metal autopart factories; head safety officer; administrative staff
	Stanford University; global academic partner universities; professors; instructors and teaching assistants from Stanford and global partner universities; industry liasons
	health workers and patients at rural homes and clinics; Ministry of Health (MOH) -- a local nonprofit organization; supervisors in district-level and province-level offices of the MoH; decision makers at the national level of the MOH; CommCare; Financial Donors; drivers (delivery of vaccines)
	researchers conducting community-level interventions; local public health agencies (LPHAs); Center for Disease Control and Prevention (CDC); American Red Cross; NIH; first responder groups; government

	computer scientists; anthropologists; and welfare case workers; AI group at University of Kentucky; case managers; advisees; Bill Clinton
	The Royal Government of Cambodia; USAID Cambodia; private importers; manufacturers; distributors; retailers; masons; NGOs; IDEO consultant; Jeff Chapin; IDE Cambodia staff; WSP staff; Ministry of Rural Development staff; World Toilet Organization; Lien Aid; local NGOs; concrete producers; latrine owners and non-latrine owning households; villagers; local government officials at the district commune and village level meetings; neighbors
	clinicians; clinic staff; University of Chicago programming team; Chicago-based family planning clinic; app testers; patients; clients
	Department of Health in South Africa (SA-DOH); lactating donor mothers; PATH; Human Milk Banking Association of South Africa (HMBASA); faculty at the Nelson mandela School of Medicine at the University of KwaZulu-Natal (UKZN); King Edward Hospital (KEH); milk bank supervisors; milk bank technicians; neonatologist; local engineers; baby; Seattle subjects
	University of Washington Department of Radiology; Ernest Cook Ultrasound Research & Training Institute (ECUREI); sonographers; radiologists; research team; frontline healthcare providers; local voice actor; nurses; ultrasound instructors; traditional birth attendants; health worker (CHW); rural mothers
	TB Tech research team; clinician teams; medical superintendents; clinicians; Ministry of Health officials; laboratory mangers; pharmacy managers; medical directors; TB care providers; AMPATH administrators and program managers; data quality workers; community health workers; Moi University; Indian University
	NGO in Southeast DR Congo; information design graduate students; Women in the Congo (WITC); Tenke Fungurume Mining; international development NGOs; Pact; Rawbank
Design With: Including End User	
	Chinese and Swedish drivers
	industrial design students from California College of the Arts; first-year engineering students from UC Berkeley
	technical experts from India and Switzerland; Atmospheric research institute; local NGO in Chennakeshava Pura (village in Karnataka): mkrishi
	schools of Design and Management of Los Andes University in Bogota -- Colombia; companies that students work with; low income neighborhoods; Colombian- Asian restaurant; students; professors
	UNICEF Malawi; local builders and villagers; District-level Environmental; District staff members; Health Officers (EHOs); assistant EHOs and health surveillance assistants; construction specialists and householders; CLTS program
	non-profit organization in Pakistan; trained designers; local community member; children; parents; 4 designers
	Southern Health Improvement Samity (SHIS); students; parents; teachers; NGO members
	healthcare service providers; insurance companies; government; pharmaceutical companies; pharmacy retailers; equipment suppliers; medical managers; patients; practitioners
	Original Equipment Manufacturer (OEM); Base of the Pyramid (BoP) user group; marketing; facilitator
Design By	
	Veolia Water; Eric Lesueur (member of Veolia Water's senior management team; Professor Muhammad Yunus; Grameen Health Care Services; Veolia Water AMI; Drishti Research Center
	One Laptop Per Child (OLPC); Fixit Clinic; SWIFT banking group; Inter- American Development bank; community organizers; children users; Paraguay; teachers; other banks

	Alameda County Public Health Department (ACPHD); local economic development agencies; food access projects; city and county government; community clinics; housing; and parks and recreation; Steering Committee
	inexperienced designers (undergraduates); clients of a cooperating solar panel company; Eight German Human-Computer-Systems and Media Communication undergraduates; rural african dwellers
Design By: Including End User	
	research team (South African & European); local (South African) Deaf NGO; ICT Developers; industrial designers; Deaf education specialist; Doctor; hospital staff; SASL interpreters; Telcom
	local senior pharmacy; industrial design engineers; students; pharmacists; deaf education specialist; computer scientists
	survey firm in Kazakhstan; president
	residents of the target community; community residents; community historian; street walkers; drug dealers; police; authorities
	Original Equipment Manufacturer (OEM); mobile phone marketing managers in Iran; 15 volunteers; mobile communication companies
	none
	village people; researchers; academics; textile weavers at Houey Hong Vocational Training Centre for Women; A Craft Initiative; "Design for" team
	Egyptian citizens; undergraduate students
	virtual online forums; Q-Zone/Tencent; taxi drivers; female part-time servants; company owner;
	Food and Agricultural Organization of the United Nations (FAO); Balimi Food Security Company (BFSC); Jeffery Hughes; William van Zyl; Soweto Scholars; Bella Martin and Bruce Hanington; Singanapalli Balaram; RITTEL; Meadows; Pirsig; Ian Smillie; Small scale farmers; University of Johannesburg
	director of the neighborhood association; state representative; chairperson of neighborhood planning unit; university president; technical assistant; community cultural arts organization; community historians; Atlanta community planning committee; local policy makers;

We also inquired about what insights these authors reported about the nature of participation while doing HCD+D work. In doing so, we received a wide variety of answers about the complexity of participatory practice. We found with this analysis the papers approached the concept of participation in unexpected, diverse, and useful ways. A broad survey of those Insights and specific case studies that add context to some essential narratives about participatory HCD+D design work are below.

Design For

When the authors mention other actors in the ‘Design For’ category, they do so by focusing on their broad designation, usually based on demographic indicator that that makes them an end user. This label represents a mindset that represents the communities based on what they lack. This is depicted in multiple papers: there is mention of focusing on the “average customer [42],” on “immigrant” and “undocumented” communities [43], and adults with low computer literacy [44], and end users with no formal education [45].

In the ‘Design For’ case studies, there is little designation about who or what could be done to have the communities engage in participation. There is mention in certain papers about how the authors understand too little of the user’s context to be able to understand the needs of the communities: “The third significant challenge is that the context of product use is so different that the engineer’s intuition is not as reliable as it is for products that will be sold in the engineer’s own context [46].” Papers also talked about how “distance [between the authors and the end users can include cultural, physical, geographical, and psychological differences” between the authors and their users [47]. As a result, some papers mentioned how they wanted to become more participatory, and even took quantitative data on the importance of including end users in the design process but did not mention how they should include them in the process [48,49,50]. Interestingly, there are certain situations where the authors mentioned how the process was “participatory,” and even how important it is to include the community’s culture in the design of the technologies [51], but the research and design methods described in the paper show no evidence that other people besides the authors participated [52].

The example narratives below represent two notable studies who were coded as “Design For’. In the paper, “Usability of implementing a tablet-based decision support and integrated record-keeping (DESIRE) tool in the nurse management of hypertension in rural Kenya”, the Academic Partnership Providing Access to Healthcare (AMPATH) program was developed to, among other priorities, develop an Android tablet-based electronic Decision Support and Integrated Record-Keeping (DESIRE) tool to record patient data and assist with clinical decision-making [53]. The authors investigated the usability of the DESIRE tool in the setting of nurse management of hypertension in rural western Kenya using “mock patient” encounters and “think aloud” exercises. In these environments, the nurses of Kenya identified twenty-three design amendments to the project, but it is altogether unclear if the nurses, or other actors, designed any part of the process, or if they simply reported back the data they were assigned to report, so the author could then further chart the design journey. Moreover, the authors said they included the local nurses in the early stages of the design process. However, it was unclear if the stakeholders all agreed that the tablet-based interaction platform was the correct and holistic solution for the problem of shifting hypertension-based tasks from the doctors to the nurses, or if some people were excluded in the problem forming and technological development phase. What is intriguing about this process, is the fact that the short paper mentioned how they demonstrated a “participatory, iterative, human-centered design process”, when it is unclear how participation actually occurred in the design decisions. This insight infers how different actors define ‘participation’ in different ways; what one stakeholder calls participation another might consider exclusion.

Another ‘Design For’ narrative arises from research in the United Arab Emirates, where they investigate the development of efficient, contextually appropriate, useful, and safe incident management systems by utilizing user-centered design ISO protocol 13407 (the previous protocol to ISO 9241-210) [54]. The paper reports that “Incident Management Systems (IMSs) have been proposed as powerful tools to enhance the coordination and management of rescue operations during traffic accidents. However, most of the available commercial IMS solutions are designed for large metropolitan cities and within the contexts of developed nations.” In the case study of the current IMS system at the time, established in the United Arab Emirates (UAE), the incident management process is as follows: “The process, described above, suffers from many limitations, including (1) absence of a database, capturing incident response information, (2) labor intensiveness due to excessive paperwork and bookkeeping, (3) lack of visibility to patrols’

location and availability, (4) time-consuming process, (5) vulnerability to human-induced errors, (6) lack of optimized decision making, and (7) lack of seamless coordination among the various involved parties." The narrative did mention the importance of using more participatory activity to address certain issues, such as "refining system requirements through successive iterations; until an "appropriate" system is developed." However, the process of outlining accident contexts, making strategic decisions, outlining design activities and implementation, are left out of the text, as well as who should be involved in each of these tasks.

Design With

Here, there are similar designations of the types of users included in the process as in the 'Design For' case studies. In most studies the end users and intended beneficiaries are depicted by these researchers by what they lack. For example, the authors use designations such as end users with dementia [55] and 'distant populations' who cannot read [56] in these studies. However, researcher-designers began to grapple with how, and why, participation can be a good thing. For instance, they mention how "[the] supply chain consists primarily of small, independent enterprises with little coordination; no one actor has a view of the whole chain [57]." The authors also reflect on having "a great deal to learn from colleagues who have not traditionally participated in global media and research exchanges [58]." Some authors reflect on their privilege and power in the project over other stakeholders, stating that "the use of project resources, its rhythm and its eventual outcomes are driven by the computer scientists, given their more powerful location within the structures that inform this [59]." Conversely, some researchers begin to grapple with why participation is a more complex beast than originally claimed. Examples include one stakeholder, who describes a story of a failed project. They mention how stakeholders who see participatory design as "only democratizing and emancipatory are complicated by incommensurable economic and political realities within the project..." The author also mentions how institutions of research keep them from developing spaces of participation, by mentioning "Given the research obligations and reward structures at US universities, is it feasible for communication researchers to spend the time to build trusted relationships with colleagues in developing nations, which may not yield publishable research or quantifiable results for three years or more [58]?"

In the With End User category, these qualities are seen in the stories as well. Many of these authors describe the struggles with engaging in participatory practice: managing stakeholder expectations to build trust, the danger in raising expectations by approaching the community, communities who feel left behind in the innovation process, and stakeholders who felt the process furthered the careers of the scientists more than it improved livelihoods of the farmers [60]. In this paper, they also outline four modes of stakeholder participation:

> "contractual, consultative, collaborative and collegiate. In the **contractual mode** the farmer's involvement is similar to that of a paid participant in a typical HCI study. The farmer acts and gets remunerated as a service provider of land, resources or services to the research project. The **consultative mode** follows a doctor-patient relationship in which the researchers try to elicit problems and suggest possible solutions to the farmer. In the **collaborative mode** the role of the farmers is more emancipated as they engage in continuous collaborations with the researchers as partners in the research process. This goes beyond typical user involvement in participatory designs in which participants rarely have ownership of the object of research and its insights and therefore obtain no direct benefit from the on-going research. In the **collegial mode** the researchers actively encourage the farmers to pursue research and development in rural areas."

Another author spoke about a project where the participation of multiple stakeholders became difficult because their "goals and behaviours are likely to clash [61]."

I included two example narratives of 'Design With' projects below. In "Adapting usability testing for oral, rural users," the researcher-designers are aiming to address the problem of usability testing frictions with communities in Ghana without competent literacy levels or with orally focused communication cultures [56]. By developing and testing the Talking Book, a handheld, durable, battery-powered device used for user-friendly recording and listening, the authors aim to test whether oral, rural users can easily document their stories, and to user testing alternatives for other similar interventions. In this dynamic, the designers acknowledge not just how the cultural knowledge and qualities of the context are different, but even the thought processes of oral societies are radically different from our own. Thus, the international NGO Literacy Bridge modified an initial plan for user testing through insights from field experiences and existing research, and local staff then adapted the plan to be culturally appropriate for the two Ghanaian villages. Another critical insight from this study is the importance of different types of 'distances' between populations; "Distance can be Geographic, cultural, or cognitive, operative in terms of language, literacy, disability." The designers acknowledged how communities have varied experience from them and took those into account when considering how those communities should be involved when developing these types of solutions.

In the next 'Design With' narrative, titled "Community Engagement for Translational Disaster Research: Fostering Public, Private & Responder Group Partnerships," the researcher-designers employ human-centered design methods to develop community-involved plans for health crises of communities who have experienced disasters. The paper mentions the need for research-aligned participatory approaches, like CBPR, which give opportunities to align the community with methods of investigation and to ensure alignment of use and sustainability of projects with the community [62]. Moreover, the paper makes the case that technological interventions aiming to help crisis environments – such as Hurricane Katrina – cannot be sustainable unless this community develops a relationship in the adoption, design, and implementation of said technology. The authors artfully describe the potential hazard, especially in 'developing contexts', that exists when designers fail to engage with the community.

> "Yet several decades of experience on engaging communities in research-based interventions – particularly for those most at risk – suggests that omitting systematic, process-based community guidance of these technical solutions is a prospect that is, at best, doomed to expensive and often predictable failure. At worst, some of the solutions developed have the potential to do more harm than good. Not because the information scientists working in this domain intended to do harm, but because they may not have fully addressed or even have been aware of cultural nuances that impact the acceptance, utilization, and interpretation of these systems [62]."

This paper also speaks about the importance of different types of expertise involved in the design process, which should be valued, and included in the development process. Stakeholders with different expertise offer the opportunity for multiple backgrounds, experiences, and ideas about how to address the problems at hand, which the authors prioritized in this paper.

Design By

In the ‘Design By’ projects, it is evident in the text that the inclusion of other communities is valued, helpful, and emergent. The power of the researcher-designers to unidirectionally control the projects and their capability in assessing, determining design decisions, and managing future work has declined – assumptively, for the betterment of the project. In these projects, community roles were explicitly outlined. Participation didn’t only become a part of the process, it became part of the solution. The authors describe in certain cases how community set core elements to ensure the intervention was “possible and successful: strong leadership; dedicated staff; shared vision and ownership; flexible partnership structure; support for building [the community’s] partners’ capacity; broad collective goals that build on partners’ strengths and priorities; and funds to promote learning, sharing, creating, and launching projects [63].” The authors in one case described opportunities for “…residents to express their views on the village’s water problems and choose the discussion topics themselves [64].” However, some authors still described events where the end users depended on subject matter experts in certain projects, which shows how added participatory practice doesn’t mean more participatory outcomes: “Though in both case studies the participants were meant to be more involved, they often gladly ceded control over the repair to the staff or coaches with the most experience….these case studies...ultimately reified notions of expertise [65].”

As was expressed before, there were many more ‘by end user’ than ‘by’ projects. We conjecture the reason the authors find more reason to include the end user as a part of the design project if they see value in ceding power during the design process. The authors gave designations for the target users that reflected their human capacity instead of their impairments, by stating that “Although many of the Deaf participants are functionally illiterate, they are experts about their communication realities [66].”

In other studies, the users completely reshaped and dominated their design space initially intended for other purposes. Authors wrote about how internet users in internet fora in Asia created communities and developed personal identities which were taboo to subvert oppressive regimes. Though these members did not design the code or the software themselves, the intervention was centered on these forum communities, and how their activities allowed for subversive protest by creating a space for “analytic discussions about religion, politics and society [67]” or to create online avatars and communities [68] on national social media sites.

Another author also defines a lingering philosophical quandary: what it means to be a part of a community. Other authors critique the fact that the ‘place’ where design is practiced is complex and difficult to determine; one paper adopts a definition where the word ‘community’ represents a “turn…towards engaging and socially meaningful sites of work.” Why does this matter? Each of these studies represents a project that aims to solve a community’s issues, but few of them outline what the community is, and who should be a part. Each innovation project represents a socially meaningful site of work, and this paper offers an answer to that lingering question: *the people who should be considered as a part of the community are those who can offer capacities that are socially meaningful to the problem at hand*: be them knowledge, subject matter, connections, lived experience, or resources. In this, their proximity to the community is less a boundary, but a spectrum defined by their proximity to the innovation context.

In the 'By' Category, the two case study papers represent two insights on the same project, from the same collaborators: "Community Historians: Scaffolding Community Engagement through Culture and Heritage," and "Strangers at the Gate: Gaining Access, Building Rapport, and Co-Constructing Community-Based Research." Both written by Le Dantec and Fox, they describe the research experience collaborating with a cultural arts organization in Atlanta, Georgia. The purpose was to "develop a design intervention which explores community members' use of technology to support community engagement." Over the two papers, the author outlines the history and context of the community where they intended to work, by mentioning how the city experienced stifled economic growth, the loss of access to public institutions like elementary schools, public roads, and storm drainage, and how generations of broken activism and failed projects developed into a great distrust for non-governmental organizations (NGOs) and university representatives. These understandings caused the representatives to reframe their goals to ensure everyone got something useful from the collaboration. They reframed the roles of their collaborators to "Community Historians" to facilitate a space where their expertise is valued, and developed a space where stakeholders could ideate, plan, and implement camera and sensor technology to "further community goals, to communicate values, and to extend the collective capabilities of the community by developing a conceptual understanding of technology as a malleable resource [69, 70]."

Actor Characterization: Which Roles Matter to Designers?

There are many ways that one can categorize the actors mentioned: by profession, by the type of project they worked on, and by how involved they were in the project. However, to understand who was allowed to participate during these design projects, we decided to map the different stakeholders who were mentioned during parts of the HCD+D process. We post-hoc affinity-mapped the collection of stakeholders from each of the case studies and then characterized the stakeholders based on their proximity to the researcher-designers and the target users, and the purpose they served during the process. Stakeholder positions are defined below.

Authorities – These are the actors, mostly on international or global scales, who act as the large agenda-setters for the issues at hand. They are usually far away from the intervention to be mentioned and are called upon because of their reputation for setting the moral and technical direction of the complex issues the designer aims to address.

Supporters – These are the organizations which serve the designers with the resources to engage in the project. Resources might include institutional reputation, funding, networking capacity, laboratory facilities, human capacity, or other necessary resources on this front.

Authors – As the intellectual proprietors of these design research narratives, they have primary say over how the stories will be told – and who has power over the design process. Any information rendered important- or unimportant – is included as they see fit. They hold a certain amount of power to determine whether participation is even a priority in the design process. Moreover, these categories are defined by how the authors decide to present them – in essence, in what way the author considers the stakeholders useful.

Expert Colleagues – These are colleagues, and/or experts in their fields who address fields which are considered critical while developing the new intervention. Their knowledge, skills, and resources are considered important for successful implementation of these interventions. Doctors, programmers, researchers, and many more fall in this category.

International Connectors – These are the stakeholders involved in international networking and collaboration. They serve as communities which exist in two worlds: the international design teams, and the community context. What they might bring to these spaces is the ability to adapt, connect, and apply certain contexts to each other.

In-State Organizers – These organizers are very similar to their international counterparts, but they are described differently by the fact that they are in-country and are somewhat disconnected from the capacity to connect outside of the country. Their expertise is in understanding and connecting the external researchers to the user context – which might include cultural and institutional knowledge and personal stake in the sustainability of the project.

Direct User Representatives – These are representatives who work directly with the end users. They are in a special position to assist the users of technology with the reach, development, spread, and deepening of the use. They aim to connect the end users to other communities, in ways that are logically useful in the designer's mind. Examples here are parents who are necessary to connect with their children in useful ways.

End Users – These are the targeted wielders of the developed intervention. In much of human-centered design, they are intended to be the focus, and in these design projects, choosing how to categorize which community to design for or alongside is a relativistic and contextual art. In the cases outlined in this HCD+D analysis they are often depicted in HCD+D contexts as a community with a problem for the authors to solve, instead of a stakeholder with capacities that might contribute to beneficial innovations.

Intended Beneficiaries – In certain instances, the wielder of the technologies are not the ones who will ultimately benefit. Examples include clinical and medicinal interventions, where the end user might be a nurse or other health professional. In this instance, the intended beneficiary is the patient. We do not assume the word 'beneficiary' assumes that the intervention will eventually be for the person's benefit, in this definition, we emphasize 'intent' as the intervention is focused on direct advocacy for the person who cannot help themselves.

In the 'Design With' category, there are a wide variety of different stakeholders that were included in the design process (when it wasn't the end user), from direct user representatives such as social psychiatric nurses and coaches what were previous students of a design program, to in-state organizers such as medical organizations working to connect the researchers with their end users, to expert colleagues, such as physicians, sonographers, and radiologists local to the researchers' locations. These activities show an increased understanding of the utility of different types of actors towards designing new solutions to the problems, who can assist with this activity.

In the ‘Design By’ category, there are also a wide variety of different stakeholders who are involved in the process: from students who developed low-fi prototypes to help facilitate the communication of energy usage to Kenya’s energy consumers, to a wide variety of stakeholders who collectively formed a multi-sector collaborative for health equity, to direct user representatives who conducted repairs on behalf of the community. Moreover, as the projects shared more design power, they also included more beneficiaries closer to the end user.

Combining Social Analysis and Participation: Method and Analysis

We can learn more about the HCD+D community by combining methods from the previous studies and analyzing the outcomes. The research team I co-led that wrote the aforementioned HCD+D Systematic Characterization did this as well: By combining methods of “HCD+D: When” and “HCD+D: Where,” we determined whether developed and developing countries conduct research outside of their country, and we learned which countries housed HCD+D research in 2004 and 2014. To continue this trend, we found useful insights by combining the social network analysis method with the participatory methods detailed above.

As expressed in the co-author network publication, “by their very being, HCD practitioners are knowledge integrators and cross-disciplinary connectors [33].” The ability to participate, and to collaborate across communities, in some ways represent similar skills. First, we employed social network analysis, a method to map and measure relationships between connected entities, to investigate if there are relationships between how authors collaborate across projects, and how they participate during a project. Using visualization techniques from social network analysis, we applied the insights from the participation paper to the connections between the authors. By visualizing how the participants participate with end communities between connections, we were able to further describe relationships between design practice in this population.

In the spreadsheet, we listed each paper by color, with ‘Design For’ as red, ‘Design With’ as yellow, and ‘Design By’ as green. By using node color rather than width to encode participation type, we could then code each co-author edge by their color of participation, representing a network of participation clusters. Each author’s relationship with another author represents how they collectively described participation during their project. Using this tool, we can determine if there are relationships between who collaborates with whom, and how they participate. What this analysis reveals are that authors are likely to engage in the same type of participation, and overall the participation style of the collaboration teams stays the same as well. Though there are some who practice a few different levels, most do not. A picture of the colored network is available below, in Figure 6.

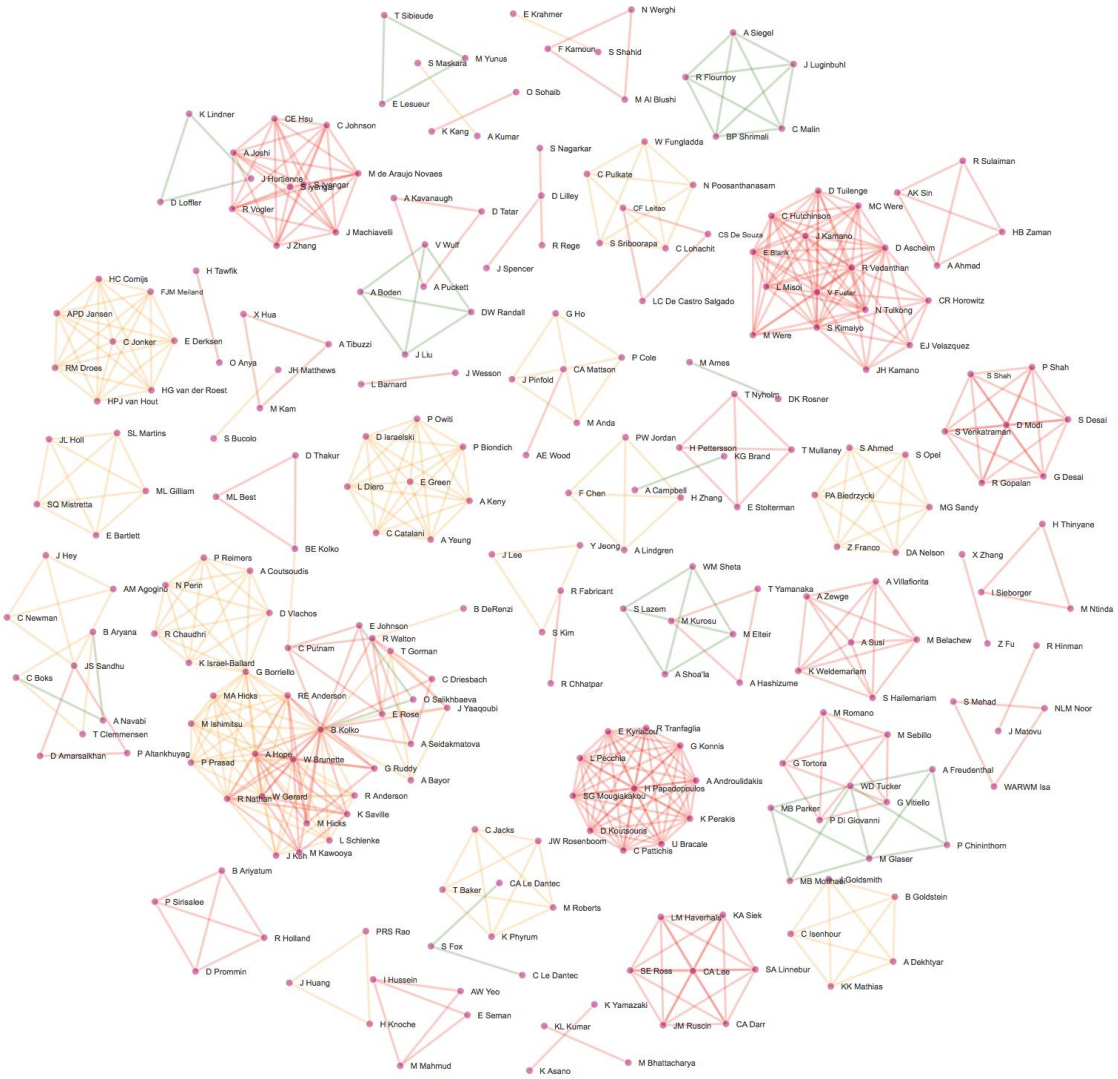


Figure 6: HCD+D participatory network of authors.

There were 178 ‘Design For’ authors, or 67.2% of the population, 102 ‘Design With’ authors, or 38.5% of the population, and 43 ‘Design By’ authors, or only 16 % of the population. It is clear that most of the design clusters share a single participation level; one can infer that each of these levels represent design teams, and teams rarely shift from a single style of participation. However, 14 authors, or 5.3% of the population, did engage in multiple forms of participation. Those authors are listed below, on Table 4.

Table 4: Authors who engage in more than one form of participation.

Author	'Design For' Papers	' Design With' Papers	'Design By' Papers
JS Sandhu	1	1	0
E Johnson	1	0	1
B Kolko	7	4	1
R Walton	3	1	0
C Putnam	2	1	0
E Rose	2	1	0
W Brunette	2	2	0
W Gerard	1	2	0
A Hope	2	2	0
RE Anderson	1	1	0
R Nathan	1	2	0
B Aryana	0	1	1
C Boks	0	1	1
J Yaaqoubi	1	1	0

What is interesting about these authors, however, is that three of the four cut-point authors depicted each have conducted multiple forms of participation (JS Sandhu, R Walton, and B Kolko). What's more, the most active researcher-designer, B Kolko, is the only one who displays all three forms of participation in the study.

Though B Kolko is the multi-participatory cutpoint who connects two much larger clusters than any of the other cutpoints, we note that she is the rare researcher who has practiced all types of participation at some time during her career. As the fields have a significant amount of disconnected micro-clusters, it is difficult for the communities to learn from each other. As a formative contributor in this field we see what can come of broadening relationships to different connections between those networks: the possibility of varying levels of participatory design practice. This analysis affords a valuable lesson about how lenses of analysis reveals opportunities for analyzing design practice. As is the example for all the methods expressed in this first chapter, combining the participation analysis with social network analysis gave us an opportunity to search through this population of data, illustrating the utility of network visualization in design practice.

Conclusion: On Participation

This chapter applied a design participation method to categorize the HCD+D design research and described insights on how these papers perceived the act of innovation. 53% of the studies and 67.2% of the authors practiced 'Design For', 38.5% of the studies and 28.9% of the authors practiced 'Design With', and 28.9% of the studies and 16% of the authors practiced 'Design By'. We also outlined the types of stakeholders that were described and involved in the design process; roughly; as the papers moved up the participation ladder, they collectively involved a larger variety of stakeholders with more diverse responsibilities. Moreover, a wide variety of issues were broached about the dynamics of more participatory innovation practice, including reframing goals and outcomes of the collaborative practice, valuing unexpected consequences, and defining traditionally undervalued roles of expertise. It must be clarified, however, that actual design projects are likely to have all three, and even more gradated levels, of participatory action during the design process. In participatory work, who has power over the parts of the design process is directly tied to many variables: privilege and power, personal capacity and expertise, team dynamics, and project requirements and needs, just to name a few. Because these findings represent what the authors, who have power over these design narratives, considered important enough to report upon; it offers an opportunity to see how these authors consider the concept of participation should align with HCD+D in their own practice.

There is much to unpack about how the lens of participation is useful for each of these individual projects. One important thing to notice is the diversity of researcher-designers views on participation in their individual projects. Though these projects share many themes, each project which actively mentions and includes participation contributes intriguing insights about which actors they include and why, how the authors describe their inclusion, and what comes of the work. What we can learn about these insights for future projects, is the importance of assessing the capacities of designer-researchers and of nontraditional design stakeholders when deciding how participatory the project should be. More participation, for participation's sake, is not the answer to better design, in HCD+D or otherwise. Context determines how participation becomes useful: the who, how, where, what, and why of a project shows how participation influences innovation practice. More than anything, **participation is not a silver bullet, but a lens which colors the design process and outcomes in its unique way which must be used if design methods are to contribute assured benefit to their desired communities**. With this, I suggest all disciplines under the banner of Innovation practice – HCD+D, Participatory, User Experiences, Human-Computer Interaction HCI, Service design, Sustainability-centered, Value-sensitive, and many others – at least consider adding the dimension of participation to their work. Doing so doesn't just mean asking impacted stakeholders their opinion, gathering data in a unidirectional fashion, to be collated and evolved into a quasi-helicoptered solution. Rather, participatory design should consider how these communities could contribute, why they should, and how designers of all types can show value for their time and experience.

Why should innovators consider participation? Because certain insights that are critical to the design process become more visible as participation increases. It affords the opportunity for stakeholders who would traditionally hold less power over the design process to be considered as useful experts in their own right. Moreover, the insights of the designers during the more participatory projects *reflect a more mature understanding about the quality, practicality, and nature of participation as a topic*. As these authors include participation as a lens, a practice, and

an outcome, they gain the ability to view contexts that necessarily include the people in them. These authors, with a unique collection of power over these narratives – financial, social, and intellectual, might find opportunities to leverage those resources to ensure they include the full humanity of the people influenced by the scope of the project. Eventually, it would be valuable to develop space for target beneficiaries of all types to spread their own design stories.

What Does a Systematic Review Mean about Innovation Practice?

A systematic review of HCD+D, as was analyzed in multiple forms here, questions the purpose and focus of engaging in systematic study of design fields. The truth is, the word 'systematic' carries with it definitions from different fields, and the findings from this research infer those insights should not apply to this or other transdisciplines in innovation practice. In many fields, there are three significant reasons as to why people engage in this type of study, each that build upon the last: to synthesize and produce new information about a topic, to develop a reproducible system that another independent researcher could use to reach the same insights, and to develop insights that are externalizable to other contexts. These reasons beg the question that started me on this path years ago: if the review outlined here is systematic, does that mean we can say the insights are reflective of other design and innovation communities?

Unfortunately, this is not the case. The reason why, however, is not any fault of the systematic method, but of the purpose of the field of design itself. First, we must talk about the bounds around what is considered design worth researching. In this study, the inspiration for the search methods was to look for people who call themselves human-centered designers, who narrate useful, logical and clear narratives of their projects, to learn about the breadth and influence of the field. Though there are design journals and datasets of human-centered designers (such as the OpenIDEO website), a broader collection of innovators is captured by Google Scholar search, and the stories are likely to be more in-depth. However, we could have drawn our boundaries a different way: by looking for any researchers who address poverty issues throughout all of history, or networks of design professionals, or compendiums of design-based journals, or by searching for research which claims to use well-known HCD method sets. If we use these methods which draw certain boundaries around design innovation, they reflect a different definition of designer, and each of these searches would have different populations, various styles of practice, and possibly different insights from another type of search. Most importantly, even if we conducted a systematic review on each of these communities, their insights still wouldn't represent the rest of the design community.

The second issue has to do with the design field captured in the review. As expressed previously, there are many fields that can be considered innovation practice and some practitioners abhor the name human-centered design. These definitions are often conflated and there the delineation between the fields is hotly contested, fluid, and changes based upon the designer who uses the fields. I argue that design semantics are critical to design practice: two designers might use the same term 'human-centered design' and ascribe noticeably different methods and mindsets. While many design-based and development-based keywords could be used to create the dataset, the collecting, assimilating, and analyzing the fields would turn into a process with no end.

Finally, the insights from the analyses above reveal qualities about the nature of design. As is shown by the many insights in this multi-paper analysis, design teams utilize the field as superficially or as deeply as they want to. The field draws from a litany of methodologies, and innovators apply the field to an extensive collection of issues and contexts, with varying amounts of participation from external stakeholders.

Although innovation practice fields are new, what matters here is the field itself is designed to be fluid, amorphous, and adaptive to the disciplines and contexts towards which it is applied. It is understandable that people aim to draw boundaries around the field to understand what it is, and how it is different, but 'pinning down' fields of innovation practice in the tradition of older fields limits the breadth and depth of the field's evolving applicability. This also means methods used to 'pin down' these fields, like systematic literature reviews, can help increase learning about the activities, actors, and insights of the community, but it does not mean their insights can be rigorously applied to all innovators in all settings. Ultimately, aiming to determine a single unified truth about what design is, can be applied to, and is for, serves to limit the useful possibilities of the field.

With that in mind, how are these methods useful? This question offers into the primary purpose of these methods, and the learning that design researchers can genuinely take from this research. Though the insights that describe human-centered design are useful, what is more critical to the researcher are **the methods listed here that researchers can apply to other design disciplines.** Design researchers can apply social network analyses to participatory design to determine how connected the authors are to other design projects. Participatory analysis can reveal the stakeholders' level and style of influence in user experience design. Who-What-When-Where-Why questions can describe the landscape of service design practice. Research like this offers alternative methods and frameworks to compare different fields of design, to reveal contexts (places, disciplines, people, or problems) of innovation practice yet unrevealed, to see if design values align with design practice, and to learn about the spread and influence of design disciplines. Moreover, projects like this stress the importance of sharing and analyzing design narratives. Each of these methods and more can be used to analyze, distill, and learn from design stories, not to develop an algorithmic model for how to approach all issues, but to develop an ever-evolving toolbox for how reactive, evolving, social designers interact with their world.

Chapter 3 | Innovation + Evaluation

"The wicked problem solver has no right to be wrong – they are fully responsible for their actions."

- Richard Buchanan

Aligning Evaluation + Innovation Theory

Figure 7: Tools available for the Market Activity during 2016 Botswana IDDS Summit.

I distinctly remember diving into the research around innovation practice, searching for research opportunities that poked at the gaps between innovation practice and other related fields. Inside the field of design, I saw many opportunities as a fledgling researcher. At the same time, I also wanted to ensure that my research had a tangible impact on an existing community. As I learned more about the innovation theory and practice, I noted a personal disconnect between the theory that researchers formulate and practice the professional houses facilitate. So, early in my Ph.D. work, I realized that my path to make a difference through my research was to develop a project steeped in real life activity. I would have to develop the plan, pool the resources, and establish the relationships many students lean on their professors for to make the project successful. I developed relationships with many design houses, entrepreneurs, and researchers who would be interested in research for mutual benefit from scratch; a process that had few results.

During this process, I remember attending a pool party with some acquaintances while at home in Maryland. They told me about their interests as policy wonks, and I remember how their work on Capitol Hill fit neatly into understandable, practical boxes. When they asked about my work, however, they became confused at my inability to explain design's amorphous nature. An acquaintance asked, "well if you're focused on the innovation process, how do you know if it'll have an impact?" Suddenly, everything clicked. It's the question I was asking all along. How do innovators determine the impact of their design activities? How can one tie the fields of innovation and impact?

After I committed to learning more about evaluation, I strove to find resources on Berkeley's campus to answer this burning question. Fortunately, a few courses were present in Public Health, Development Engineering, and Business, which taught the basics of the practice. Unfortunately, the more I learned about the practice, the more I felt like these methods didn't fit the innovation methods I've been researching. The more I learned about the cutting-edge methods of evaluation for development, the more it revealed the gap of how innovation for international development remained a pressing research gap. Though innovation practice and impact evaluation seemed useful individually, researchers who presented the fields together could not describe how the fields could be practically aligned. **Why does the gold standard of impact evaluation not fit with the adaptive and collaborative silver bullet of innovation practice?** I had to find more. Before I did that, however, I had to reconcile why the two fields didn't practically align. I present this philosophical reflection in the next section.

Epistemological Misalignment: On Innovation Practice and Impact Evaluation

Fortunately, there are recent movements to combine the fields of innovation and evaluation. Examples include multiple national conferences held that aim to combine the fields of evaluation and innovation: from the American Evaluation Association's 2016 Annual Conference [71], and the Measured Conference that focuses on the Impact of Social Design in Human Health [72]. On the individual level, Carberry, Gerber and Martin developed tools that measure self-efficacy towards innovation [73]. Royalty, Ladenheim, and Roth worked to create assessment tools to determine if design thinking learning and application is allowed in organizations [74]. The Design Management Institute has developed many resources that make commercial case for facilitating design practice. One example is the Design Maturity Matrix, which gives organizations categorical ladders of expertise of design-based systems: during development and delivery of products and services, in the systems and processes inside the organization, while positioning and approaching the business' strategy and modeling. Also made available on the website is the Design Value Index, which tracks the value of public companies chosen that succeeded on design management criteria. According to the Index, the sixteen design-centric companies over the past ten years outperforms the S&P 500 by 211% [75]. Findings of these practices vary, but we can perceive a few insights: there is an interest in developing corporations' capabilities towards addressing their intended user's needs through design, and these organizations look for financial, organizational, and efficiency-based benefits based on those activities [76].

A contentious debate in innovation practice is how it even should be measured in the first place. The *Oxford Handbook of Innovation* points out that much of measurement activities, a primary focus of evaluative activity, thrives on commensurability; those who measure outcomes assume "there is at least some level on which entities are qualitatively similar, so that comparisons can be made in quantitative terms." The primary problem with measuring innovation is how the field represents novelty, which can make it difficult to produce comparable performance outcomes [77]. The aforementioned *Parts Without a Whole* study mentioned related concerns in design thinking practice as well. They found that an extensive collection of design practitioners and organizational respondents perceive design thinking as trying to measure. According to the survey, most respondents do not measure it at all, and the ones who do, use vaguely coherent metrics. Only a minority of respondents have felt any financial benefits from design thinking so far, so experts interweave a mix of innovation journey stories with relevant key performance indicators to showcase and trace back the field's actual impact [23]. Though management stakeholders

traditionally focus on the final innovation outcome, the study mentions how the process requires executive commitment, financial support, topic-related awareness, space and dedicated free time to change the way they work and how they approach problems along the way to respond to the needed adaptability. Organizations who don't do this and try to introduce design thinking methods may lead to unintended consequences that question existing management roles.

At the same time, impact evaluation has increased in interest in the fields of international development recently as well. In 2011, the book Poor Economics published by Banerjee and Duflo was released, which added an exclamation point on the growing field of impact evaluation, when randomized control trials became considered the 'gold standard' of economics research. Donovan posits that "Proponents have depicted RCTs as the key to conclusive knowledge about 'what works' in development through their engagements with multiple publics, including academics, aid workers, policymakers and... the 'donating public' [78]. Governments, such as the United Kingdom's, place considerable emphasis on using randomized control trials to achieve 'value for money' as incentivized by an international focus on improving the effectiveness of international aid programs. These governments therefore advised USAID on evaluation policy, and subsequently directed the Hewlett Foundation's development work by explaining that evaluation can 'lead to better use of money' by aid organizations. The director of the Abdul Latif Jameel Poverty Action Lab (J-PAL)'s director Rachel Glennerster and Harvard's Michael Kremer valorize RCTs for allowing funders 'to design successful and cost-effective programs.' This discourse enhanced the audibility and value of the 'randomistas', the practitioners of this gold standard [78].

And so, the field grew proportionally to its interest. The very presence of the International Initiative for Impact Evaluation (3ie), founded in 2008, which develops resources for researchers, expands services increasing the quality of, synthesizes and informs policy around impact evaluations. A study of the growth of the field sponsored by 3ie by Cameron showed that of the 2259 studies published from 1981 to 2012, annual publication increased dramatically after 2008. This increase corresponds with the seminal events such as first published evaluations of the conditional cash transfer program Progresa in the late 1990s, the creation of institutions like the Abdul Latif Jameel Poverty Action Lab (J-PAL), the World Bank's Development Impact Evaluation Initiative (DIME) and the Strategic Impact Evaluation Fund (SIEF) at the World Bank [79].

In this, it is understandable why there would be interest in aligning these two fields together. It seems useful to show if innovation practice methods could be invariably shown that they develop a wide variety of beneficial outcomes to a community plagued by poverty-influenced activities. In fact, 3ie has been conducting a study for the past few years of the impact of Creative Capacity Building on Local Innovators in Uganda [80]. In full disclosure, I found through my research activities below that the facilitators of the workshop in Uganda have roots in the International Development Innovation Network, the same community I collaborated with for the second and third chapters of this dissertation.

However, the more we learn about what it takes to align design practice and impact evaluation in beneficial ways, it is clear the fields do not quite fit. What if the designers use methods not included in the study to be evaluated in the future? How much involvement does the end user community have in setting the essential metrics in the impact evaluation? Is the evaluation sure to capture all the unintended and beneficial consequences of the design workshop? Delivering solutions with rigor and quality hold entirely different meanings in the two fields, and there does not yet exist a reflection on why there is such philosophical misalignment. To make sense of this, I will further

outline the incongruences between innovation practice and impact evaluation, so development interventionists can be clear about the utility, capacity, and boundaries of the methods. The purpose of this section is **to outline theoretical purpose of two widely popular methodologies in development**: by showing how the fields draw from differing epistemologies and are thus made for different contexts, assume different skill sets, and aim to address different problems, both are valid and useful but not omnipotent.

Amorphousness vs. stringency. As mentioned in the previous chapter, innovation practice represents a new, amorphous, and evolving field. *Parts Without a Whole*, mentioned previously, reveals that the definition and use of design thinking vary widely by actor and context [23]. Depending on the organization, its depth of use ranges based on the stakeholder. Some regard the field as a methodological toolbox, which includes methods of understanding, brainstorming, and prototyping to be used as accessory methods for their primary tasks, and others idolize the field as a mindset that primarily drives how the complex problems of our society should be solved. As was shown in the previous chapter, fields of innovation practice are influenced by methodologies in many separate fields, each which contributes its own methodologies to complicated issues concerning gender equality, global partnership and cooperation, water and sanitation, economic inclusion, and global health and education, among others. The **amorphous** nature of the field aligns with the types of problems it aims to solve. 'wicked problems', which are a class of social system problems that are ill-formulated, have many clients and decision-makers with conflicting values, where the ramifications of each component within this whole system are thus thoroughly confusing [81,82]. In this space, developing useful methodologies that apply to communities who address "conception and planning of the artificial" requires systematic yet evolving methods.

Impact evaluation, however, is a part of a broader agenda of evidence-based policymaking [83]. To ensure governments develop political will among various stakeholders and contextual environments, and to ensure that the interventions are containable and repeatable across any political and/or geographical contexts, the methods prioritizes control over the scope of the intervention. Successfully planning, implementing, and studying a single intervention over the years and with extensive cost and political expertise requires a culture of **stringency**. Before specialists implement the evaluation, they must agree on a robust theory of change to be evaluated as well as a clear and unchanging community and context through how the intervention is distributed, such that impact evaluations are designed to be specific, logically valid, and unchanging. The 'rigor' of the method is itself evaluated on its ability to adhere to a set of rules. For instance. the baseline of the control group must be adequately similar to the treatment group, as many unobservable variables besides the treatment condition should be isolated and counted to determine effects across metrics and to rule out confounding hypotheses of influence. Also, the statistical power of the test must also be sufficient before the evaluators can believe the study's outcomes. In doing so, the evaluators intend to, without a doubt, show evidence that nothing but the intervention established at hand was the cause of change. As a result, the projects that have tried to evaluate innovation processes and outputs have constrained the method's capacity to specific contexts (classrooms, businesses, communities), indicators (creative capacity and confidence, market price, technological spread), and program models (curriculum or organizational structure). In innovation practice, the context that requires amorphous and dynamic solutions sees the rigidity as stifling. To gather knowledge, designers must rapidly prototype and be ready to reframe the problem to be addressed. Impact evaluators, however, see design as indeterministic and wishy-washy. Clearly, the fields are built to serve differing purposes.

Context vs. externalizability. Design as a field has deep roots in anthropology and ethnography: by understanding cultures, and learning about and from people in those cultures, addressable problems arise, and designers can consider them from multiple points of view. As a democratized offshoot of centuries of evolved design work, innovation practice works best when done with a deep **contextual understanding** of the community's issues it aims to address. By developing a deep understanding of the community, the designers can best formulate technological solutions that fit those community's needs. The ability to make sense of the context, to build and share said understanding, and to utilize tools that apply to the context to change the state of society requires a "toolkit" from which the designer can draw from at any time, consistently evolving but rarely repeated in the same way in different spaces.

Impact evaluation, however, is created to incentivize **scale** as a critical impact measure. As was expressed before, a critical purpose of impact evaluations is to develop a large-scale social experiment that adheres to statistical rigor and searches for a causal relationship between the program activities and the desired outcome indicators. Impact evaluators categorize studies into two different broad types: an efficacy study, carried out under circumstances highly controlled by the study designers, or effectiveness studies, which take place with minimal experiment controls in real life environments, using implementation channels currently available to those who would enact the policy. Though efficacy studies are more controllable and more straightforward to implement, effectiveness studies are more likely generalizable to the population that the data frame represents [83]. Another important consideration is if implementers could potentially repeat the outcomes in other locations. These questions guide 'successful' impact evaluations: if someone else were to do the same research design, would they come up with the same outcomes as before? And, would the same outcomes be reached, even in different locations?

3ie, among advocacy and publishing of impact evaluations, also publishes systematic reviews or collections of individual impact studies on the same topic in different contexts. As of this writing, it contains almost 303 summaries of systematic reviews drawn from a range of sources and sectors [84]. It also has published what it calls evidence gap maps, which aims to consolidate what we know about development sectors or thematic areas to determine where the evidence lies. The standard for high quality is more evidence and high effect sizes: impact evaluations, systematic studies, and protocol studies (essentially, setting the stage for future experimental studies) in research practice [85]. To reach its purposes – filling holes of evidence, developing spaces and making them accessible for policymakers – requires the tests to be replicable, instead of contextually influenced.

Collaboration vs. Expertise-based exclusion. Innovation practice, in theory, can be taught to and implemented by all types of people in wildly diverse contexts. Organizations such as the LUMA Institute target Fortune 500 companies by developing workshops and publishing resources on their website [86]. IDEO has published a wide variety of resources, including online books that help funnel design thinking into schools [87]. The literature review in the previous chapter outlined examples where the authors valued community representatives, children, and even illiterate communities in the design process. As expressed in ISO 9241-210, another critical principle of the work is the inclusion of multidisciplinary skills and perspectives in the design team [34]. Requiring different expertise, skills, lived experiences, and resources to **collaborate** on a design team leverages the opportunity to have the members' sense-making, creation, and iteration occur together in unexpected and novel ways, which blossoms unforeseen and unique solutions.

However, impact evaluation, and other fields that aspire to its standards, are designed to be used by a small population of experts. They require a collection of difficult-to-acquire analytical skills, such as experience with a statistical software packages like R or Stata. Designing, implementing, and analyzing the research designs requires significant funding, time, and political capital, and the actors must simultaneously cater to the interests of entities that intend to represent large communities: countries, multilateral organizations, and global NGOs. It is even the case that the evidence from an evaluation design is considered higher-quality, and thus more valuable, if the communities are **excluded** from the process. Because controlling for confounding variables and bias is necessary to extract cause during design, the Hawthorne effect, a research consequence where a subject who knows that they are being observed might alter their behavior, becomes a significant effect that impact evaluators are incentivized to control. In an evaluation, not controlling for the Hawthorne effect might mean true causality is lost.

On Epistemology

The frictions between the fields abound. What impact evaluation calls 'spillovers' or 'contamination' of outcomes or activities, design might call an opportunity for active modification or creative collaboration. Where design aims to collect stories of change as the evidence of impact on a community, impact evaluation is most comfortable with quantitative metrics of income, morbidity, or crop yields that are useful on regional scales and repeatable across contexts. In understanding the critical difference between these two fields, we must realize the foundation of that difference is the epistemological misalignment between the fields.

Epistemology, to be explicit, is the theory of knowledge. A way to interpret epistemology is as a philosophy of how you determine what is real and what is belief. Impact evaluation, whose methods and focus areas come from econometrics, epidemiology, and business, is influenced by positivism, which as stated in *Research is Ceremony*, espouses the view that there is one true reality that can be broken down into clear laws. Through objective thought, it should be possible to discover this one reality. In many ways, positivism is the domain of traditional science and can be seen in scientists' quests for universal laws and Rules of Nature. Through this epistemology, impact evaluation aims to develop an understanding of the problems of the world, what solutions exist to address these issues, and which solutions, if designed logically and controlled effectively, can create solutions that align to these laws.

However, innovation practice is influenced by both critical theory and constructivism. Critical theory argues that reality has been shaped by our "cultural gender, social and other values. To help some old reality through their influence upon it." Thus, the epistemology is shaped by researchers who interact with their people and contexts. Constructivism takes that concept a step further, in saying, "There is not merely one fluid reality, but many realities specific to the people in locations that hold them. Reality then is what you make it to be. The interaction between the investigator in the subjects is the key to this epistemology, with reality made up of socially constructed concept that are shared. The goal is a coming together between researcher and subject to create a mutual reality to find common meaning in the natural world [22]." In design practice, the collaborative teams, complex contexts, and "wicked problems' they aim to solve aligns much more cleanly with varying contexts, constructed realities, and collective knowledge from these fields.

Both fields are growing and finding useful ground in the international development community. Some of this growth, however, reflects how the fields feel fashionable at this point in development practice, and occurs because their methods are useful in addressing transdisciplinary gaps in their fields. Though they are not relegated only to these positions, innovation practice thrives at problem-finding, at early-stage development of innovative solutions at the application of methods to many varied problems, whereas impact evaluation is influenced by large-scale issues such as behavioral economics, epidemiology, agriculture, education, and health, among others. Unfortunately, most of this nuance about which approaches work in which context is lost by the 'sexiness' of the fields. By considering the fields as a "silver bullet" or a "gold standard," it assumes they are applicable in all development contexts.

How, then, does the confused development practitioner move forward? What matters here is situation recognition: no evaluation or innovation method is the best for every environment, and understanding what works requires the practitioner understand the complexity and dynamicism present in the context. Michael Quinn Patton, in his foundational text *Developmental Evaluation: Applying Complexity Concepts to Enhance Innovation and Use*, outlines the importance of learning the space in which you are intervening. By describing the environment as technologically simple or complex (are there interventions yet to be designed that must be created to address the issue?) and socially simple or complex (is there stakeholder disagreement between what the problem is, and how can the conflict be addressed?) are critical towards understanding the method. The purer the problem, the more straightforward the plan can be to solve it; the more complex the problem, the more emergent, adaptive processes are necessary. Moreover, as is rarely discussed in depth in design circles, it must be stated for whose success we are advocating. As expressed in Gargani's "What Works for Whom, Where, Why, for What, and When? Using Evaluation Evidence to Take Action in Local Contexts" [88], evaluations do not live in a vacuum. The question "What works?" must always be a qualified answer (by whom, for whom, where, for why and what, and when a program will be effective). What is critical as well in understanding who is determining success, so that they ensure the evaluation is rendered useful to the populations in mind. Evaluators and designers must not only ask stakeholders what success is when addressing a problem, but that the outcomes – the evaluation insights, the policy outcomes, or the design activities and interventions – must be specifically curated to the user's benefit. Patton mentions that evaluations are critically influenced by "the personal factor," defined as whether there is a person or community that personally cares about the findings the evaluations will generate. Research on evaluation use shows, in contexts where the personal factor was absent, a correspondingly marked decrease in evaluation impact [89].

None of this means that the transdisciplinary fields cannot be adequately aligned; we only must careful as to how they should be married. Transformative interdisciplinarity can come from communities who seemingly have nothing to do with each other. Until then, however, we have found intellectual room both for impact evaluation and innovation practice in development interventions. Evaluation as a field, however, is much more extensive than the controlled studies of impact evaluation would have us believe: Stufflebeam outlines and analyzes twenty-two separate evaluation methods from the beginning of the field to the end of the 20th century, of which controlled experiments like randomized trials are only one of many; and the approaches are growing and evolving year after year [90]. However, finding ways to pair the positive qualities of innovation practice with evaluation methods without limiting the approach's participatory nature and fluidity remains a challenge. If impact evaluation doesn't align, what does?

Combining Evaluation and Innovation Practice in International Development

There is rising interest in learning how innovation and evaluation can address issues tangential to global poverty. The flagship social design consultancy, IDEO.org, developed a partnership with the UK's Department for International Development, which aims to catalyze the open innovation platforms of OpenIDEO into investment opportunities for early-stage solutions that address development concerns. They have attacked such issues as making low-income urban areas safer and more empowering for women and girls, making urban slum communities more resilient to the effect of climate change, and expanding economic opportunities for youth in East Africa [91]. Such influential actors as Australian Aid, the Bill & Melinda Gates Foundation, Global Affairs Canada, the Global Innovation Fund, Grand Challenges Canada, Results for Development, Swedish International Development Cooperation Agency (SIDA), The Rockefeller Foundation, the UK's Department for International Development, the United Nations International Children's Emergency Fund (UNICEF), the United Nations Development Programme (UNDP), USAID, and the World Bank Group have collaborated in building the International Development Innovation Alliance (IDIA) in 2015 as an informal platform for determining the role of innovation within international development [92]. Among their roles are the gathering and sharing of information on the impact of innovation activities on global poverty issues around the world. There are also growing examples of development-centric innovation and design organizations who show the impact of their work. Examples include IDEO.org's "Impact: A Design perspective report" [93], and D-Rev's impact dashboards for the ReMotion prosthetic knee and the Brilliance Infant Jaundice Lamp [94], which both report global spread statistics for their technologies, and personal insights about their design practice.

In these discussions, there is a wide variety of questions that arise at the nexus of innovation and evaluation practice. Each of the previous topics brings up varied evaluators, metrics of success, evaluands (the actor to be evaluated), different purposes, and intended policy suggestions based on their outcomes. In this, one gap that exists is learning how a collective system of innovation actors would interact, research, study, or practice entrepreneurial activity as a part of a cohesive, contextual unit. While learning about this innovation community and their goals, their activities, the struggles they experience, and their influences, I developed the linchpin question to keep the research afloat: **How do innovation actors evaluate?**

People in different hierarchical positions, organizations, and jobs who conduct activities will evaluate with different definitions of success, with different methods, for different purposes. Moreover, different community members evaluate based on varying scopes: at national, organizational, and community levels. Learning about how stakeholders innovate and evaluate to address the multifaceted problems of their society, how an ecosystem of innovators operates, how their evaluation activities support or hinder the context, and what they can learn from each other helps us understand how they envision their future, how they plan, and what clues they use to navigate towards that brighter future.

An underlying assumption of the work here, which reflects the broad applicability and presence of designer mindsets, methods, and activities of these stakeholders of innovation, is that they engage in evaluation activities and mindsets but that they might not call them evaluation methods. I ensured the actors appropriately understand the research design and purpose and can easily answer the questions. Thus, we are interested not just in the evaluation capacity, but the evaluation culture

of these communities. Examples of an evaluation culture in academically nontraditional form include different definitions of reality and knowledge worldviews, the narration of future stories, the use of proverbs, the development of groups voting and consensus, and many others. Chilisa, Major, and Khudu-Petersen advocate for the development of tools and research that invoke proverbs to engage in a culturally responsive dialogue, as they "can be analysed to reveal and express social, cultural, natural, and community events and practices." This activity supports co-research activity and can support decolonizing research [95]. In this way, we aim to peel back the goals and principles these communities' value while determining the merit and worth of activities. These qualities include, but are not limited to:

- The future reality they envision caused by their activities, (what success looks like)
- What actions they believe will get them there,
- The logic as to how this happens (Theory of Change, overall logic)
- Why they value this future over others (values, priorities)
- Who chooses the reality they envision (stakeholders, loudest/officializing voices)
- What information they collect to get there (quantitative/qualitative data and metrics)
- How they collect the information (e.g., interview, sensors, surveys)
- How they analyze the information (e.g., affinity map, computational, assumption)
- What biases they might have (or acknowledge themselves) towards analyzing their data (personal, collective, cultural)
- What techniques they use to verify the truth (e.g., regression, experimentation, divergence)

Ethnographic Evaluation Study of Botswana Innovation Community

While searching for design practitioner and innovation organizations worldwide to collaborate with for my research, I learned about an organization that focused precisely on this topic. At the Massachusetts Institute of Technology, I first learned about the International Development Design Summit (IDDS) from a student, Jessica Vechakul, also under my advisor, Alice Agogino, after I learned about Vechakul's research experiences that influenced her Ph.D. Her case study analyses that developed an in-depth understanding of the similarities and differences between two heavily involved design thinking interventions, run by IDEO.org and the International Development Innovation Network (IDIN), the organization that ran the aforementioned summits, showed me the opportunities available to me by being involved with some design work. Moreover, I realized working with a partner was methodologically apt; to understand design research, which works best in a context, I had to be involved on the ground to truly learn about how they design and evaluate. This organization, which was housed at an academic institution, focused on the nexus of design and development, and open to scraggly graduate students, seemed like the perfect opportunity for a potential collaboration. After developing a relationship with the global IDIN office and learning a bit about their research and evaluation activities, I eventually earned the best opportunity to see the IDDS model of catalyzing design and innovation up close; the IDDS team invited me to the 2016 International Development Design Summit in Botswana. Because the global office learned about my interest in how innovation and evaluation can be paired and the entire ecosystem of interventions IDDS implements, they also gave me an opportunity to attend a Creative Capacity Building summit (a 3-5-day workshop, held in-country, for local communities) on the Okavango Delta, in the North of Botswana! I couldn't pass this up. More about that experience will come with the further case study of the International Development Design Summit below.

Eventually, as I spent my first three-month field trip in the country, I learned about how the activities occurring in Botswana were part of a much larger international push to catalyze innovation throughout the whole country. Institutions like the Botswana Innovation Hub, the University of Botswana, and the Botswana Institute of Research, Technology, and Innovation all exemplified independent actors who are navigating this space of transition. Learning more about this space, and what IDIN contributes to it, gave me an opportunity to expand the boundaries and the insights. I then began the two-year study in understanding how innovation actors in Botswana approach evaluation to benefit their activities. The findings, narratives, experiences, and analyses represented during this study are the focus of the rest of this chapter of the dissertation.

Institutional Review Board Requirements

This research was approved for Human Research by the Committee of Protection of Human Subjects (CPHS) as CPHS Protocol Number 2016-04-8671: Ethnographic Evaluation Study for Botswana Innovation Ecosystem June 22, 2016. This research was also approved by the Republic of Botswana to receive a Research Permit as Ref Number CLG 14/14/3/1 II (96): Ethnographic Innovation Study for the Botswana Innovation Ecosystem. These allowances permit the engagement of all research methods included henceforth.

Background Research on Botswana Context

One important point to note is the existing precedent in investigating the innovation system of Botswana. The most in-depth survey and analysis of this frame of research comes from UNESCO's Global Observatory of Science, Technology and Innovation Policy Instruments (GO-SPIN), which developed a report that maps research and innovation in the Republic of Botswana. The program intends to develop a knowledge base of national innovation systems to support international needs of open-source capacity building, standard-setting, and data collection resources for decision makers, knowledge-brokers, specialists, and the general public. Towards this end, the program developed the first case study of the evolving research and innovation landscape. The study outlines the background, a scientometric analysis of the country, an analysis of the policy cycle, its organizational chart and flows, an inventory of institutions, applicable legal frameworks and operational policy instruments, and an outline of innovative institutions [96]. Also included is a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) of Botswana's research and innovation system, included below in Figure 8.

Strengths	Weaknesses
• Political stability and good governance • Good investment climate • Good communications infrastructure • Sustainable GDP per capita growth (parabolic growth over 47 years) • High number of mainstream scientific publications per capita for Africa	• Low innovative capability • Inadequate legislation to promote innovation and FDI • Shortage of critical skills • Narrow economic spectrum • Research collaboration remains low • Indigenous knowledge remains largely disregarded • Slow policy implementation

Opportunities	Threats
• Capacity-building in performance and governance of research, science, technology and innovation • Prioritization of human capital development • Traditional knowledge law in place • Intellectual property law in place and compliant to international treaties. • Potential for international collaboration • Good articulation among the innovation hub, educational hub; diamond hub, agricultural hub and health hub • Coherent and complementary SETI operational policy instruments for the promotion of research and innovation by the National Research Fund and the Innovation Fund	• Excessive dependence on the State • Low participation of the private sector in research, science, technology and innovation • Poor monitoring and evaluation • Lack of funding sources for infrastructure for research, science, technology and innovation • Lack of explicit postgraduate degree policies and funding • Inadequate networking instruments to connect the academic and research system (supply side) with the productive system (demand side)

Figure 8: SWOT Analysis of Botswana's National Innovation System [96].

Any researcher willing to learn in-depth about the national landscape of the innovation system, apart from qualities related to evaluation, should read this publication [96]. A collection of eleven researchers, housed in different institutions of Botswana Government, helped develop this multifaceted report of Botswana innovation. As my capacities as a single researcher cannot match theirs, this work aims to complement and tangentially support their innovation research.

However, this research still supports the findings in the project in various ways. Though this document was published relatively recently in 2013, a central institution of this study, the Botswana Institute for Research Technology and Innovation (BITRI), was not yet functioning fully at the time of data analysis and publication of this original study, which reveals the nascent and evolving nature of this ecosystem. My research intends to offer a critical update to the involved stakeholder, and thus the insights, of the GO-SPIN policy document.

One last critical insight from the document, however, is cognizance of **poor monitoring and evaluation in the national innovation system**, particularly of deploying greater efforts of science, technology, and innovation resources in the country to better inform policy decision making. To complement this finding, the primary focus of the work henceforth is to understand the evaluation approaches of a purposive sample of innovation actors in the country. By outlining the methods and determining definitions of success, who uses the insights, and how and why these methods are deemed trustworthy, as well as other aligned questions, I intend to probe the evaluation worldviews of these community actors. Additionally, though the GO-SPIN research looked primarily at

national systems, my research holds two scopes: the national community levels of connected innovation actors and a specific innovation community in D'kar. This offers an opportunity to sense how, if at all, how their evaluation approaches are aligned and complementary.

Research Methodology

The primary intent of the research in Botswana is to understand evaluation capacity and culture. There are a few reasons as to why this is the chosen analysis frame:

- We learn from the different spaces the qualities the people believe to be critical, important, or necessary to determine success, the internal logic as to how they arrived at that form of success, and what goal might fall through the cracks.
- We understand why and how communities grapple with the idea of evaluation, even if evaluation as an activity is not fully understood.
- We might gain insight about how their context – their stakeholders, their cultural influences, their mindsets, their goals – influence the goals they reach, and how they approach the goals they intend to address.

The activities are widely varied and are intended to support mixed-method analysis with an ethnographic frame of certain influential actors in the Botswana innovation ecosystem. By using an ethnographic frame, the research is designed as a broad search for a holistic understanding of the cultures of these innovation spaces, in order to reveal a deep understanding of the communities' evaluation capacity and what could influence those capacities: their history, activities, interested stakeholders, and otherwise contextual artifacts. At least four qualities of the state of the research determine why the adaptive inquisitive approach of ethnography is useful: the context is diverse and dynamic, influenced by the culture and context, and contains unknowns to be searched for; in addition, and the study is aligned towards the stakeholder's needs and concerns.

Diverse and dynamic: Evaluation, as was expressed previously, is as diverse as the organizations, people, values, and intentions of those practicing the art. Leaning into the diversity of evaluation activity also affords the opportunity to learn how one actor's methods might be useful in another actor's context.

Culturally influenced: The way these stakeholders manifest their values, test reality, develop insights, and approach other evaluation activities are shaped by the culture in which they are involved. Learning about the qualities of the culture of Botswana affords me the opportunity to investigate how to ensure that approaches are culturally responsive.

Acknowledged unknowns: The first assumption expressed is that evaluation, as a discipline baked into all others, might be a collection of activities that the community doesn't even recognize. Being open to various activities where stakeholders' isolate values, collect and analyze data, and use those insights, leverages the opportunity to find forms of evaluation that are normally hidden.

Can be aligned towards stakeholder use: An axiological intent of this research is to ensure that the knowledge collected, the analysis developed, and the outcomes rendered are useful to the respondents. These insights in this dissertation are not knowledge for knowledge's sake; by learning the evaluation approaches, and the context of their innovation activities, the knowledge gaps mentioned by various innovation stakeholders inform the insights for the study.

It is for these reasons why ethnography as a frame is well suited for conducting this work. There are many fields, uses, and frame that use ethnography, but it usually means in-the-field preparation, inquiry, and analysis, focused on or adjacent to an understanding of people and their context. An in-depth history of its methodological use is beyond the scope of this dissertation, but a few papers on innovation ethnography [97] and critical design ethnography [98] illustrate its purposes. Researchers within ethnographic frames operate by collecting data, appearing trustworthy yet consistently being skeptical of your and people's knowledge, and creating and destroying theories created during the project. These ensure that the researcher never forgets to search for the situated and positional qualities of actors and their insights, ensure that the researchers establish context when developing understanding, that they search with passion, and that they always keep searching for depth. An augmented quote by Novalis adequately captures these principles: practicing an ethnographic frame is "...to make us aware of the magic, mystery and wonder of the world; it is to educate the senses to see the ordinary as extraordinary, the familiar as strange, the mundane as sacred, the finite as infinite." Within this frame, the methods below are used to collect data for this study. A specified articulation of the research activities follows.

Ecosystem Participant Observation

During the IDIN workshops and while visiting the various innovation communities, I engaged in participant observation and collected data on public behavior. Any names listed here represent people who have listed their contact information as a part of their public contributions in another medium; the rest of the people are confidential. These data collected about the experience includes, but are not limited to, the activities below:

- Information Gathering
- Problem Framing
- Indicator Variable Development
- Idea Generation
- Prototype Detail Design & Fabrication
- Prototype Testing and Evaluation

IDIN had already recruited the rest of the participants for their workshops through their personal project logistics, and this study takes advantage of the programs to be run to view insights about evaluation. Other public events observed included meetings at the University of Botswana and with the Botswana Innovation Hub. Overall, about 120+ people were directly observed during this activity.

Semi-Structured Interviews

I conducted semi-structured interviews with workshop participants, beneficiaries, and members of the Botswana Innovation community. Similar interview guides were used for all the IDIN programs, though unique questions did arise that related to the specific expertise of the respondent. I reached all participants through snowball sampling, and other methods intent upon reaching a sample of varied stakeholders pertaining to the program. In this work, I strove to document the connections and history of the innovation community to find opportunities for better aligning stakeholders' aspirations and mitigating institutional barriers. About 70+ people were involved in the interviews.

Focus groups

Multiple focus groups were held to hold space for consultation or facilitation of specific innovation activities while simultaneously gathering data about Botswana contexts. I held numerous workshops at the Botswana Innovation Hub, at the University of Botswana, and with the IDDS D'kar Steering Committee. I took great care to ensure the participants know their participation in the interview is voluntary when the workshops were being advertised. These included classroom discussions, design thinking workshops, evaluation workshops, and interview questions. About 70+ people were directly involved in workshops. The data were collected using snowball sampling methods. The research included people involved in the different sectors of work related to innovation. They represent expertise in conducting, facilitating researching, or teaching innovation-related topics in the Botswana innovation networks.

As the innovation activities might develop yet unforeseen outputs, the analyses used were simultaneously developmental and dialectic. The analysis revealed topics, themes, quotes, goals, behaviors, tools, and frameworks that might hinder or support evaluation capacity as it progressed, and it was open to the possibility that these artifacts might change and adapt over time. The amalgamated data for this dissertation includes autoethnographic narratives, recordings from direct interviews and focus groups, pictures, websites, documents including policy papers, research theses, peer-reviewed publications, project evaluation reports, white papers, books, design workbooks, annual reports of national parastatals, organizational histories, legislative policies, and mixed media documents including brochures, magazine documents, student directories, email and WhatsApp correspondences, art texts, newspapers, design surveys, and advertisements for public and private activities.

Altogether, there were 200+ individual people that I directly interacted with during the study. The stakeholders came from various innovation positions and experiences inside and outside the country, with a litany of personal experiences, responsibilities, organizational positions, contextual and subject matter expertises, perceptions about the innovation system, and definitions of success. The representatives came from the Botswana Innovation Hub, the Botswana Investment and Trade Centre, the Botswana Institute of Technology Research and Innovation, Botho College, the Ministry of Local Development and Rural Development, the Companies and Intellectual Property Authority, Deloitte in Botswana, Ecoexist, the Human Resource Development Council, the Kuru Development Trust, the Local Entrepreneurship Authority, the Department of Research Science and Technology, the Massachusetts Institute of Technology, the village of Moshopa, the Naro Language project, villages along the Okavango Delta, Texas A&M University, the University of Botswana, and the United States Agency for International Development. These representatives are university deans, auditors of national organizations, organization board members, C-level officers, chief executive officers, chairs of departments, design facilitators, design participants, intended design beneficiaries, professional engineers and designers, directors, NGO representatives, entrepreneurs, external evaluators, undergraduate and graduate students, lawyers, village representatives, librarians, linguists, managers, IDIN Global managers, village chiefs, professors, external researchers, subject matter expert consultants, and indigenous community members. About thirty of the stakeholders in this direct activity were affiliated with the Botswana government, about ninety are affiliated with an academic institution, about eighty are affiliated with an NGO, and about twenty affiliated with industry. These respondents were about 40% women and 60% men.

This research became feasible through critical associations I have developed while working alongside the Botswana innovation community. While attending the 2016 Botswana IDDS, I gained rapport with each member of the innovation community in D'kar, Gaborone, and other related villages. I experienced first-hand the innovation capacity of the community and its potential for measurable development by using the Innovation Center, by working alongside fellow designers, and by personally developing design solutions. My academic connections developed at IDDS blossomed into affiliations and consultation from the San Research Centre, the Master of Development Practice program, and the Department of Industrial Design and Technology, each at the University of Botswana (UB). I then developed a researcher-in-residence collaboration with BIH), which evolved into discussions with BITRI, the Department of Research Science and Technology (DRST), the Companies and Intellectual Property Authority (CIPA), and various other related innovation organizations and personnel in the country. These institutions gave me insight towards the current academic knowledge base of development and technological needs in the Botswana context. Further, my connections blossomed into relationships with the innovation communities and related stakeholders, which evolved into mutual collaborations and opportunities for data collection and collaborative analysis. Each of these activities were invaluable resources towards this study's goals.

The subsequent sections of this chapter follow the structure outlined here. First, I outline the history of the country as it relates to the institutions and attitudes of innovation. Next is a description of the flagship institutions that support innovation practice in the country; in these sections I outline a brief history of the institutions, their innovation-supporting activities, and the perceptions the stakeholders hold about them. The next section describes the creation of Botswana's development innovation ecosystem, as supported by the International Development Innovation Network. First is an ethnographic narrative of the purpose, activities, and perceptions of the Creative Capacity Building Summit in Seronga. Next is the history of the San communities in Botswana, and a history of interventionism in the village of D'kar, where IDIN stakeholders held the IDDS Botswana 2016 workshop. I then conclude the contextual section with a broad description of the history, activities, perceptions, and outcomes of the IDDS 2016 Summit. In the next section, I then outline the evaluation approaches of the flagship innovation institutions in the country and describe insights about what can be learned about their evaluation approaches. Finally, I describe insights into the cultural dynamics, attitudes, and points of concern about the Botswana innovation system across institutions and scopes.

The multitudinous histories of Botswana, the breadth and depth of innovation activities, and the future visions of the purpose of innovation are broader and more profound than what can be explained in a single dissertation. However, by isolating a collection of essential highlights about its growth and its present activities through the outlined purposive research methods, I aim to tell a cohesive narrative about the critical considerations towards benefiting Botswana's innovation practice through beneficial organizational critiques, cultural alignment, historical contextuality, and evaluation thought. The mistakes I hold as mine.

Before Institutionalized Innovation: Botswana Context and History

Figure 9: Map of Transportation, Botswana [99].

In 2016, the year I started this project by visiting the workshop, Botswana was rigorously celebrating its 50th year of independence. The whole year long, there were a wide variety of activities, put on to commemorate the rich history and experience of the country. To correctly tell the story of any institutions, the celebrations offer a terrific opportunity to show how its history contributed to the growth of its flagship innovation institutions. As it grew into itself during those early days, there were more cattle than people, and it was struggling to find itself. Since 1885, the country operated as a protectorate of Great Britain, and developed a comparatively tame relationship with respect to its neighbor countries. Many historical retellings of Botswana exist; as is described in Sigel Saugestad's *The Inconvenient Indigenous,*

> "For many years British impact was minimal. The British government viewed the establishing of the Protectorate basically to protect the road to the north, and to protect the Batswana from outside enemies (the Boers in Transvaal, later the Germans in Namibia). There was no wish by the colonial powers to spend money on administration. At the same time, Batswana as represented by their dikgosi (chiefs) were strongly opposed to interference in their internal affairs. For most of the colonial period, the British practised a policy of non-interference, or indirect rule [100]."

Moreover, the principal Tswana chiefdoms established themselves in the southern and western sections of the country and essentially ran undisturbed. Compared to many other colonized states, the country was not marred by the political conflict that other regions experienced on the national level. Saugestad states "Botswana never went through a liberation struggle, and at Independence

there was no cadre of leaders returning from exile with fresh ideas to transform the new state. The transition to Independence meant a consolidation of traditional powers, incorporated into the new institutions of the state." When Britain accepted proposals for democratic self-governance in Botswana, it barely concerned the chiefdoms and their communities.

The Diamond Industry

When diamonds were initially found the year after independence in 1967, in a massive diamond mine 250 miles away from the capital city, it directed the country on a path of development unlike many others in the world. The leading company, De Beers, entered into a 50-50 joint venture with the government, and in the 1990s, it sold Botswana a 15% stake in the company [101]. Kenneth Good illustrates in his text *Diamonds, Dispossession and Democracy in Botswana* how over time the reliance on diamonds made Botswana into, among international accounts, a development success. In its early years, Botswana was among the poorest countries in the world, with an income per capita of $80 a year; today, the country is considered upper-middle income country with a per capita income $16,000 a year [102]. Diamonds bought roads, railways, airlines, telecommunications, free education, and health facilities, while also abolishing a dependency in the government's recurrent expenditures by 1972 and introducing overall budget surpluses by 1983, even while total government expenditure was rising by about 11% a year between 1970 and 1995. Because of their primary focus on the diamond industry, policymakers determined imports to be the financially preferable alternative to the task of stimulating domestic agriculture and manufacturing, which incentivized the importation of manufactured goods from efficient neighboring producers. This decision, as they could come to learn, would lead to severely narrowed opportunities to economic diversification and transformation in the future.

In the early 1990s, Botswana's growth rate slowed dramatically, which led to rising unemployment, an issue to this day. Due to their overreliance on the diamond industry over the years, the country's leaders decided not to diversify the economic portfolio of its companies, or by supporting economies like the agricultural or service sectors. Michael Ross, a Political Science professor at the University of California, Los Angeles who studies resource dependencies, measured commodity exports as a measure of GDP, where a rate 30% is especially precarious. With a figure of 35.1, as early as 1995, he noted that Botswana was the most mineral dependent country in the world. The state has also struggled to distribute the wealth equitably; according to latest figures from the World Bank, it is the third most unequal country in the world with a Gini index of 60.5 [103]. As a result, unemployment and poverty remain two of the most significant national issues not yet addressed.

In many ways, the institutions that exist in the country are built up because of the diamond workforce. However, the country's leaders became wary about the economic sustainability of the resource over time; diamonds were not forever. Today, there are multiple pressures on the diamond trade that incentivized diversification, including the growth of synthetic diamonds, the economic strife caused by diamond used to arm proceeds of war, and the fact of depleting diamond resources.

The Economic Power of the Botswana Government

As a result, the Botswana government became the national economic powerhouse. It remains the largest consumer of goods and services in the country. In 2009 the government spent approximately $2.9 billion in public procurements, and the national procurement board adjudicates some sixty procurements per week. Much of the government services are coordinated through state-owned enterprises, henceforth mentioned as parastatals. The government also bolsters many socially beneficial national businesses that have not yet developed the capacity to reach economic independence [104]. As was recently stated by the Minister of Finance and Economic Development, O.K. Mathambo, in his 2018 Speech,

> "state-owned enterprises (SOEs) exist to support Government's development efforts. Hence, their performance is critical in achieving Government's broad development objectives of boosting economic growth, promoting economic diversification, and creating employment opportunities. In addition, Government, like any other shareholder, expect a return on investment in some of these organisations. It is therefore important that these organisations are held accountable for the public resources entrusted to them by requiring them to provide a certain minimal return on capital, and contribute to economic growth and employment creation [105]."

Botswana's mining revenue has provided the government with the resources to construct and maintain a robust infrastructure, including roads, telecommunication systems, hospitals, hotels, and schools. The presence of a well-maintained infrastructure, complemented by political stability, tends to encourage foreign investment [104].

International Competition

The country's economic output is also influenced by the competition of southern African countries in various ways as well. Tacheba, in his publication *The Science Technology and Innovation Policy Making*, outlines the role of competitiveness in technology.

> "Global competitiveness is now an important concept in economic performance and a benchmark and profiling economies…. Competitiveness is determined by the productivity (value per unit of input) with which a nation uses its human, capital, and natural resources. The primary basis for competitiveness is seeing the potential in natural capital and identifying best practices on how to optimally benefit from such. Africa typically ranks very low on global competitiveness scales, but is endowed with natural capital whilst countries that do not have such Capital are highly ranked [106]."

Regional economic competition arose especially in South Africa, where the economy was especially diversified and strong [102]. There are few products and services in Botswana that did not originate from South African countries, and the competition of these developed businesses is consistently present in the country. Multiple sources spoke about the possibility of Hyundai setting up in Botswana approximately a decade ago and started to develop relationships with the country to do so, but eventually backed out, citing too small of a market when compared to the population in South Africa.

Competition from southern African nations impact early career job seekers as well. Many of the existing institutions utilize the more developed economics resources in South Africa instead of building up the growing intellectual capacity in their own country by offering Batswana employment to do similar tasks. A university administrator mentioned how this contributed to the unemployment in the country:

> "The industry isn't quite looking for the skills students are developing in the university. The work places aren't ready to take them in. There is an economic crisis, companies are being forced to cut off employees. There is a possibility of young people to create employment for young people. Sometimes the industry isn't ready to support those skills. The culture is that the companies have been outsourcing from South Africa...Although we show that the students have the skills, many of the companies try to stick to what they know."
>
> Administrator, Botho University

The context described, which outlines the undiversified economy and the history of the economic and institutional power of Botswana, reveals a government that has developed the sole resource and capacity, and a mandate to shift the country's transition towards an undetermined form of development. Because the country has a comparatively underdeveloped independent private sector and with a wide variety of parastatals building up the role of these institutions, the government saw fit to develop institutions that can usher in this change. The history, and main events of this national transition are described below.

Transitioning Towards Institutionalizing Innovation

With this history in mind, the country is working to diversify its economy in many ways. There were a wide variety of activities that needed to happen to ensure the national institutions could support innovative activity. There is an expressed importance in addressing the meager resources established towards research. Indeed, the 2005 UNDP Report showed that Botswana did not invest in science and technology innovation and diffusion, with an investment of less than 0.5% of gross domestic product on research and development, which is much lower than the 3-4% acceptable norm for "scientifically developed" countries and the recommended standard of at least 1% of Gross Domestic Product (GDP) for countries in the Southern African Development Community (SADC). Similarly, on the knowledge economy index (readiness towards a knowledge society) developed by the World Bank, Botswana was rated poorly at 3.96 out of 10 in 2008 [107].

After much advocacy and consultation, the Botswana government also developed a document that describes the purpose, the vision, activities, and methods that support the turn towards innovation. Called the National Policy on Research, Science, Technology, and Innovation, it was revised from the 1998 Science and Technology Policy and re-approved in August 2012. The policy goals are to increase the national human resource capacity in research, science, technology and innovation, mainly by increasing the country's capacity to connect the economic growth of research, to infuse indigenous knowledge into the national research and development agenda, to innovate around sustainable technology development, and to apply science and technology to improve the quality of life of Batswana and other citizens abroad [108]. The policy outlines the development of a National System of Innovation to address these issues and as a tool for economic growth. The government's key role in the developing system is to create an enabling environment for conducting scientific and technological research and development and to stimulate innovation by:

- Promoting research and innovation in the areas of priority for sustainable socio-economic development of Botswana and fostering collaborative scientific research among academics, scientific institutions and the private sector,
- Mobilizing adequate resources, both human and financial columns, for research, technology development and transfer, innovation of development technology-driven and knowledge intensive industries,
- Providing an enabling environment for the coordination, development and implementation of RSTI policy and promotion, support and participation, and research and integration of S&T into all sectors of the economy and nurture creativity,
- Cultivating a sense of responsibility among the Science and Technology institutions in the country for ensuring attainment of high standards of quality, safety and quantity of research output as a part of their social responsibility and commitment,
- Promoting the establishment of collaborations, partnerships and linkages among stakeholders, the private sector, and international science, research and development community, and,
- By building a national culture of innovation and integration of traditional knowledge into modern science.

To do so effectively, the complimentary Implementation Plan for the National Policy goes into depth about the policy categories that must be implemented:

- the development of the National Innovation System,
- developing funding sources,
- promoting active private sector participation,
- directing the research and science directive to be driven by social, economic, environmental, business, and commercial challenges,
- developing human capital towards innovative outcomes,
- building a culture of research and innovation,
- facilitating policy promoting Safety, Ethics and National Quality standards for products,
- facilitating the commercial exploitation of indigenous knowledge systems,
- developing a supportive legal framework,
- building up appropriate information and communications technologies,
- promoting inclusion of marginalized communities, those classified by gender, youth and vulnerable groups, and
- developing useful and accurate technology monitoring, assessment, and forecasting [109]

To reform the country brand that Botswana holds economic disadvantages and an underdeveloped private industry, a large campaign was also established to focus on the benefits of bringing business in Botswana. In the Botswana Investment and Trade Centre (BITC), the Investor's Handbook makes the case by outlining beneficial qualities of economic investment. For example, Botswana outlines the political stability, peace, and transparency of the country by mentioning the high Corruption Perceptions Index, credit rating, and high competitiveness when compared to other countries, in implicit contrast with South Africa. It also describes how the country is committed to sound fiscal policy and economic freedom and has a steady and dramatic growth rate [110].

Botswana mentions how it is centrally located in the SADC region and has leveraged the capacity to access Zimbabwe, Zambia, Angola, and South Africa, among others, and the presence of its foreign reserves and recent investment of its natural resources. An employee at BIH mentioned qualities of this campaign when making the case to innovate in Botswana; that alongside having the access and infrastructure of South Africa, they are a few hours from Johannesburg, have road and railway access, and how "South Africa has very liberal labor laws, many different strikes happen in the country…Our labor force tends to be more stable."

Moreover, amendments are made not just to the innovation-centered institutions, but those focused on education as well. The National Human Resource Development Strategy, released from 2009-2022, was described as the 'bible' that helps government-supported innovation actors navigate the innovation transition [111]. The strategy of the document aims to:

- Raise the vision and understanding of the nation by encouraging its citizens to creatively reflect and engage in the development of Botswana, toward the realization of their individual capacities and potentials,
- To provide a strategic framework to guide the direction Botswana should take,
- To ensuring a strategic alignment between the nation's ambitions and individual capabilities and potentials, and
- To use education and skills development of a poverty alleviation tool for household in economics stabilizer at the national level.

After much consultation and focus, the policy memo outlines that the emphasis on isolating Botswana's future lies in investing in its people. Its vision statement is "...by 2022, it will be universally accepted that the quality, productivity and motivation of its people will be Botswana's single greatest invaluable resource" and reaching this vision is necessary to guarantee Botswana's status as a "winning nation [111]."

These documents represent how the government prioritizes transitioning from its success as a natural resource-based economy to a new economy characterized by high level skills, technology transfer, productivity, and innovation, through various policy modifications. Fortunately, with this focus, there has been some progress towards these goals in recent years. Efforts to diversify the economy have yielded positive results during the past decade, to the extent that the share of the mining sector in the domestic output declined from 25% in 2008 to 20% in 2017, signifying a corresponding increase in the contribution of non-mining sectors over the same period [105]. The rate of unemployment also declined from 26.2% in 2008 to 17.7% in 2016. Similarly, survey results published by Statistics Botswana in January 2018 show that the proportion of people living below the poverty datum line has been declining over the years, from 19.3% in 2009/2010 to 16.3% in 2015/2016. Regarding abject poverty, that is, those earning below US$1.25 per day, the rate declined from 6.6% in 2009/2010 to 3.3% in 2015/2016, or in a more relevant purchasing power terms of US$1.90 per day, to 5.8% in the latter year. In 2017, Botswana also managed to maintain an "A investment grade" rating by both Standard & Poor's and Moody's Investors rating agencies. These ratings are necessary for attracting foreign direct investment, which is a prerequisite for economic growth and job creation in the economy.

National Innovation Institutions

The organizations that interact with and support innovation practice in Botswana vary in scope, mission, activities, intended users, and outcomes. Understanding these organization's histories, what their goals and activities are, what resources/capacities they've developed, and how they interact will lead towards a better understanding of the worldviews and overall goals aligned for them as flagships for Tswana innovation. Dr. Tacheba, the director of Cluster Development for the Botswana Innovation Hub, has done exceptional work to chart the organizational structure and development of the current national ecosystem.

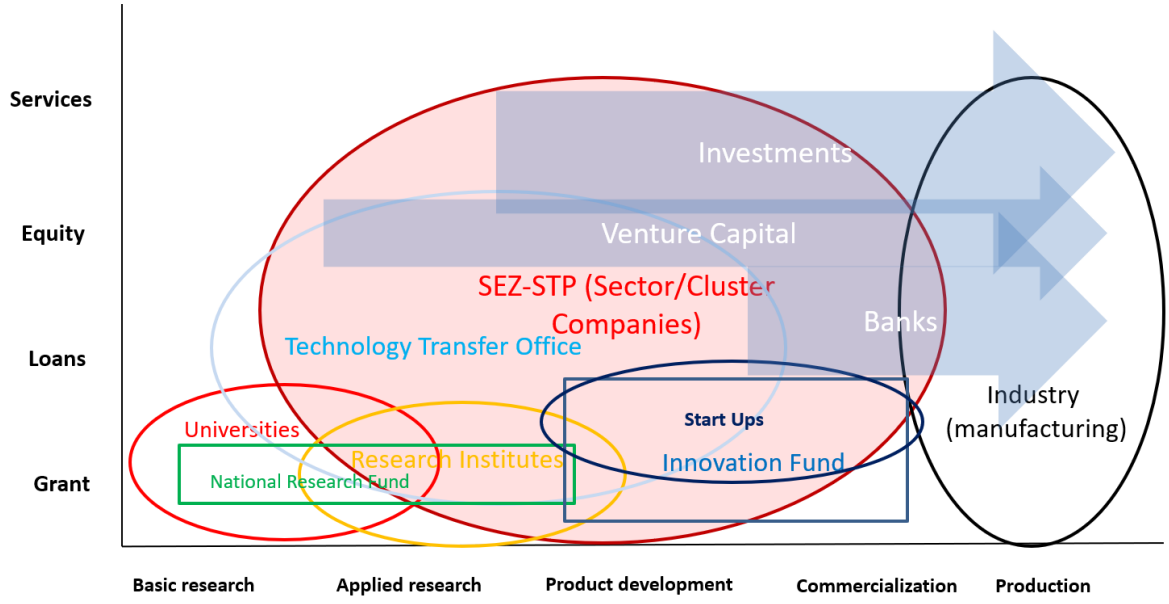


Figure 10: Institutional Organization of the National System of Innovation [112].

In Figure 10, Tacheba illustrates how institutions are intended to interact with each other towards the development of commercial outcomes [112]. The universities, such as the University of Botswana, the Botswana International University of Science and Technology (BIUST), Limkokwing University, and others, search for grants to develop knowledge that could be leveraged into applied research, towards making products and services. The research institutes are focused in the further development of technologically ready interventions while developing certain intellectual property protection and business modeling plans for furthering the technology, which would be supported by the development of a National Research Fund. They would then require Special Economic Zones (SEZ) and the Science and Technology Park (STP), which would help develop entrepreneurial and start-up development by creating workspaces and opportunities for collaboration and entrepreneurial mentorship. These startups would have access to an innovation fund to help support the early stage development of their startups. Inside each of these organizations would be the presence of the technology transfer offices, where entrepreneurs could receive guidance concerning where best to transition their intervention for further development. With growth and nurturing, the interventions would ideally be ready for investment through venture capital, angel investors, banks, and the like, to eventually reach industry. By ensuring the foundational institutions are present in the development of the ecosystem, there is assurance at least that startups will have the basic amenities they need to grow.

The parastatals were roughly categorized by how they could support the development of commercial products and services. In doing so, the stakeholders aligned the organizations to different Technological Readiness Levels (TRL), borrowed from the space industry, visible in Table 5. As was illustrated by chief employees in the Botswana Innovation Hub, the Botswana universities would mainly work towards interventions currently at TRL levels 1 and 2, BITRI would primarily address those at TRL levels 3-8, and BIH would focus on TRL 9, though there is some room for adaptation in the organizations.

Table 5: Technology Readiness Level [113].

TRL 1	Basic principles observed and reported
TRL 2	Technology concept and/or application formulated
TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept
TRL 4	Component and/or breadboard validation in laboratory environment
TRL 5	Component and/or breadboard validation in relevant environment
TRL 6	System/subsystem model or prototype demonstration in a relevant environment
TRL 7	System prototype demonstration in a relevant environment
TRL 8	Actual system completed and 'qualified' through test and demonstration
TRL 9	Actual system proven through successful mission operation

Though the institutions below are not the only innovation-centric institutions that exist in the country, the stakeholders I interacted with agreed these institutions are the national leaders of this new transition towards innovation. Thus, learning how the government supports, spreads, practices, and – most critically for this dissertation – evaluates innovation is critical to understanding how these spaces intend to shape this country's future.

Ministry of Tertiary Education

In 2016, President Lt Gen. Dr. Seretse Khama Ian Khama, while reorganizing many government ministries, created the new Ministry of Tertiary Education, Research, Science, and Technology (MoTE) [114]. Its mandate is to provide leadership in science and technology in Botswana through the provision of an enabling policy and legislation environment and coordination of science and technology activities in the country [115]. As of 2018, MoTE is allocated the fifth largest share of P4.75 billion or 10.5% of the Ministerial Recurrent Budget, which will mainly cater for tertiary student scholarships and public university activities [105]. MoTE is responsible for "policy on student financing, tertiary institutions and coordinating research science and technology development [116]."

To incentivize organizational alignment, the institutions with an 'innovation focus' were categorized under this institution. A wide variety of the innovation actors are under the purview of this ministry, including but not limited to all the country's universities, the Human Resource Development Council, the Botswana Innovation Hub, the Botswana Institute for Technology, Research, and Innovation, and the National Food, Technology, and Research Centre. MoTE houses many of the organizations that have been charged with facilitating innovative practice and outcomes.

Much of the innovation directives of these institutions are outlined in the Research, Science, Technology and Innovation Policy. To support the collaboration, reporting of activities, delegation, and the evaluation of innovation activity in the country, MoTE houses the central office that manages these organization, described below.

Department of Research, Science, and Technology (DRST)

Inside MoTE is the Department of Research, Science and Technology (DRST) that, while focusing on coordination and development of the innovation actors under its purview, also houses the monitoring and evaluation program of innovation in the country. Some specific functions of the department include:

- the reviewing of the prevailing research and development situation regarding investment in all sectors of the economy in the return it generates,
- reviewing, monitoring and evaluating the availability and adequacy of research infrastructure, equipment, and manpower for research and development,
- monitoring the implementation of identified strategic priorities of research and development in measuring impact developing the national science, technology, and Innovation indicators [117].

The organization works to manage the office of the Minister and the consummate organizations, and, to a smaller extent, the relationships between the organizations themselves. The DRST representatives, towards this end, have mentioned how they aim to develop a "database for the different type of innovations and try to track the development of those innovations, and then get work in collaboration with companies and intellectual property agencies for those that have the potential for protection… to work for eventual commercial development, through the Botswana Innovation Hub."

Botswana Innovation Hub

Tacheba's chapter investigating innovation systems outlines the importance of a wide variety of governmental policies to develop an innovation community, such as tax breaks, labor incentives, empowering entrepreneurs, job entrepreneurship development, and the housing of entrepreneurs in a single location to develop rich innovation-centered institutions [106]. To align with these policy suggestions, the Botswana Innovation Hub was founded in 2008 to become the central place that offers space, resources, programs, mentorship, and branding of innovation-led entrepreneurship. Though a private entity, BIH is a parastatal, which is common for Botswana institutions but is unique as a startup hub organizational structure [118].

The company was initialized as a product of the National Excellence Strategy of 2008 that proposed a three-pronged national strategic goal: economic diversification, job creation, and moving the country towards a knowledge-based economy. The company was incorporated to:

- develop and operate Botswana's first Science and Technology Park,
- contribute to the country's economic development and competitiveness by technological and indigenous knowledge-based business opportunities,
- Add value to the existing companies, foster entrepreneurship and technology transfer, generate knowledge-based jobs, and
- Attract innovative companies and institutions to the Botswana Innovation Hub.

It aims to attract corporations, startups, and entrepreneurs by offering high-quality infrastructure that includes roads and street lighting as well as uninterrupted water, power, and ICT connectivity. The Hub also offers special incentives for its registered companies and institutions, which include:

- networking, research, and technical collaboration opportunities locally and internationally,
- a concessionary 15% corporate tax rate for qualifying companies,
- eligibility to import specialist skills and personnel under a special Botswana Innovation Hub dispensation,
- access to the technology entrepreneurship program run by the Botswana Innovation Hub,
- access to the Innovation Fund run by Botswana Innovation Hub, and
- access to a range of technology transfer and commercialization services [119].

These incentives are widely advertised in business circles as well: the Botswana Investment and Trade Centre, an integrated authority aiming to attract foreign direct investment, lists BIH in their advertising materials as offering service-oriented sectoral Special Economic Zones (SEZs) with the 15% tax listed [110]. BIH isolates the five technological areas it focuses on to ensure social and economic alignment National Directives, which are Clean Technologies, Information and Communication Technologies and Enabled Services, Biotechnology, Mining, and Indigenous Knowledge Systems [120].

Per the development of one-stop-shop-based policy interventions, the activities at the Hub are advertised by and aligned with many of the commercializing entities proclaimed through the country. The Innogram magazine illustrates how BIH aligns with to the National Vision 2016’s pillar of achieving a prosperous, productive and innovative nation. It aims to develop advanced Science and Technology Innovation capital and activities in the country by attracting innovators, channeling the requisite support services, and conditioning the investment climate. It intends to do this by facilitating new scientific, technological, and indigenous knowledge-based businesses, and aims to foster entrepreneurship and technology transfer to develop start-up companies, add value to existing companies, generate knowledge-based jobs, and attract innovative companies and institutions to the Hub [119, 120].

As was emphasized in the article by Tacheba, the BIH Science and Technology Park is the geographic linchpin of the SEZ to be implemented in the country, intending to attract companies, increase efficiency between parks, and facilitate areas of collaboration. The government broadly advertises the constructed Icon Building where the park is housed. Constructed by the New York architecture firm SHOP, the office notes its 57 hectares of land, established for potential future businesses, that are located close near the Sir Seretse Khama International Airport and adjacent to the Diamond Training Centre (DTC) in the capital city of Botswana and close to the center of the country's business activity. The hi-tech way the building was designed is also a critical branding focus for the architect's office and BIH itself, as they constructed the building through Virtual Reality headset technology [121]. At the official Launch of the Hub, Vice President Kedikilwe, PH, MP mentioned all these qualities to the global community in 2012; how Science and Technology Parks are being established to facilitate innovation like in South Africa and Mauritius, and how BIH is currently advocating for LEED certification [122].

Startup Company Development: First Steps Venture Centre

"Across BIH, there's a lot of so-called capacity building."

BIH Executive

A main activity of the Hub is to house and facilitate the growth of startup companies. The organization that mentors these companies towards reaching commercial independence is the First Steps Venture Center. Their mentoring and startup coaching organization, the First Steps Venture Centre Business Coaching and Mentoring Sessions, received 3000+ attendants in the span of two months, and their networking workshops obtained over 6000 participants in the same time interval. They house two types of clients: virtual clients who do not hold room in BIH, and in-house clients who can rent out room for their organizations.

There are many examples of startups they have managed, in fields of advertisement, education, financial technology, industrial design, information and communication technologies, and more.

Botswana Innovation Fund

Also, BIH houses the Botswana Innovation Fund. The purpose of the Fund is to (as explained in the supplementary legislation):

(a) "promote innovation through technology, product and business development in the private sector by providing cash grants to
    (i) companies and organisations registered with the Botswana Innovation Hub; and
    (ii) universities and research organisations inside or outside the Botswana Innovation Hub, to which companies and organisations registered with the Botswana Innovation Hub may subcontract part of the research and development work; and
(b) encourage companies and organisations registered with the Botswana Innovation Hub to transfer skills to citizen employees by providing cash grants to be utilised for-
    (i) institutionalised training, and/or
    (ii) approved on-the-job training programmes [123]."

The Fund was originally set by a Board of Trustees and is now set by a Committee, instructed by a governmentally set mandate. The Fund aims to facilitate grants of different values for different communities. A BIH representative mentioned that the Fund was set by a parliamentary instrument as a policy instrument separate from but housed inside BIH. Organizations that receive certain levels of funds are required to pay back into the fund to support the sustainability of the Fund for future entrepreneurs.

BIH Partnership Development and Advocacy

> "We work off of relationships. You might have had networks that work off of all the previous entrepreneurs, but when you have people that work in thirty separate [disciplinary] spaces...That's why you need to have a pool of mentors."
>
> BIH Employee

The Hub also advocates for partnerships and relationships that will facilitate resources, knowledge, and institutions for Batswana startups. BIH has developed many diverse relationships with corporate sponsors, local and international universities, international innovation advocacy bodies, and more. Open for service in early 2018, it currently houses the anchor tenant companies of Dimension Data, Radiation Protection Inspectorate, Alpha Direct, Thermo Deck, and Microsoft. A wide variety of startups have been involved with the development of their activities, which address issues including but not limited to cell phone registration, biometric finance technology, social media consultation, company branding, online wedding services, and financial consultation.

The BIH CEO Alan Boshwaen also has directly advocated for increasing the network of other Science, Technology, and Innovation Parks in Southern Africa. As the elected President of the International Association of Science Parks and Areas of Innovation (IASP) Africa Division, he mentioned how he wants to grow the network given that the Africa network is the smallest of the IASP Regions. Unlike other regions of the world such as Asia, North America or Europe, science and technology parks or dedicated areas of innovation are still in their infancy in Africa, and his term as president intends to facilitate their growth [124].

Recently, BIH developed a relationship with the Stanford SEED Program, which was funded by independent philanthropists focused on addressing global poverty. The program facilitates the scaling of small and medium-sized businesses. The activities came in the form of four-week business training sessions that brought lessons and mentoring to the chosen companies in the country. Once the startups complete the programs, the alumni form a network of those companies that can further collaborate and better develop their activities. So far, there are 300 companies worldwide who serve as a network base.

The Botswana CleanTech Centre of Expertise Programme idea is a benchmarked adaptation of the Finnish National "Centre of Expertise Programme." It established the development of incubators, which concretely assisted aspiring entrepreneurs with advice and tools to create, develop, or increase the growth of clean tech in the country [125]. Botswana Innovation Hub also entered into a partnership with The Innovation Hub Gauteng to benchmark the Entrepreneurship development program, First Steps Venture Centre. The partnership will find synergies in all aspects of client services focusing but not limited to incubation administration, program access, procedure management, service support structures, exchange programs, and recruitment and evaluation processes.

Additionally, The African Innovation Foundation (AIF) signed a Memorandum of Understanding (MoU) with the Botswana Innovation Hub (BIH) to formalize their partnership, aiming at strengthening ecosystems and commercializing innovations in Botswana, as well as promoting a culture of entrepreneurship across the country. The Memorandum of Understanding (MOU) aims to: develop an effective national competition and robust BIH process for vetting innovations and mobilizing Innovation prize Africa (IPA) applicants, support the national systems of innovation, and build the capacity of local innovators and broaden existing networks [126].

Many different BIH employees have discussed how the development of practice relationships between organizations is a prime directive for the company, and that developing MOUs that outline and make permanent those relationships will continue to occur as time progresses.

Hosting Events

The largest event to date that BIH hosted was the 5th Innovation Prize Africa (IPA) event [119]. The international organization was started by the African Innovation Fund to strengthen innovation ecosystems with a litany of activities and resources, the largest of those is an annual conference and competition held in revolving African countries. Held in Gaborone in late June 2016, it held a wide variety of experiences, including but not limited to: "Africa's first ever Innovation Ecosystems Connector, a space that held "work thinks", maker spaces, innovation rock stars and a vibrant cultural African village of food, music and art [127]." I personally had the opportunity to attend, and view booths of international startups, and workshops on intellectual property.

BIH also hosts events related to innovation or topics related to the National Directives. For example, the company held Annual World Telecommunications and Information Society Day in collaboration with Ministry of Transport and Communication (MTC) and other ICT stakeholders joining the global community in commemorating the annual World Telecommunications and Information Society Day (WTISD) on May 17, 2016.

There were also plans to start holding Roundtables. A BIH employee mentioned how there was profound deep interest in developing spaces for trans-organizational collaboration about the cutting-edge issues and obstacles of any topic. By putting together subject matter experts, entrepreneurs, corporate representatives, and legislators, it gives folks an opportunity to learn from each other and develop opportunities for moving forward in research, business, and policy. According to BIH representatives, it can serve as a "...good reality check, to see how policies we write in parliament, ...to see how they are for the businessman on the ground."

BIH also aims to advertise its resources and capacities multiple ways. The organization holds Road Shows to publicize the lessons, activities, resources, and possibilities of BIH to the rest of the country. BIH employees mention the more abstract goal of the roadshows is not solely to increase interest in innovation practice, "... you're trying to change their mind they're trying to change their understanding of what Innovation is. ... It's about (1) an opportunity to diversify your product, or (2) Solving an actual problem. There's one problem we actually focus on, is a lot of businesses aren't coming in solving actual problems."

In certain instances, FSVC entrepreneurs also advertise on behalf of BIH at conferences and road shows, so they can leverage the opportunity to promote their projects. BIH managers mentioned how talking about the novel Science and Technology Park served no purpose for the conference attendees, that "they don't want to hear that,' but by letting the startups hold space there, they 'have stories to tell about their products and services...When they shine, we shine."

Nearly every Friday, there are coffee sessions that connects fledgling entrepreneurs to experts in a wide variety of fields, to learn about what it takes to succeed in innovation. They also advertise international competitions and hackathons and hold resources for certain BIH members to attend to compete. Within the past two to three years, a startup had participated in Russia, they ran a Hackathon through their collaboration with Microsoft, and certain FSVC members have attended the African Innovation Fund competitions.

I first interacted with many of the BIH representatives through these coffee sessions. I also got a chance to see their mentorship and startup accelerator, the First Steps Venture Center (FSVC), from the outside, by viewing how entrepreneurs applied for the subsequent class of mentorship. By visiting a few coffee sessions and speaking to some BIH veterans, I learned of the many workshops are intended to be opportunities for budding entrepreneurs to learn from veterans about 'what it takes to succeed'. It usually is in a lecture-based manner, where the presenters give a relatively long presentation, and the audience has an opportunity to express their thoughts unearthed by the workshop. I asked the entrepreneurs and a few BIH employees what opportunities exist for different types of meeting spaces: either for participants to connect, or to work on their own innovative ideas. As I heard there were few, I found an opportunity to hold such a space, by developing a workshop that aims to build the social capacity of the Botswana innovation community, through a seminar of this sort.

By running a design thinking workshop on increasing the social capacity of Botswana innovators at a coffee session, I developed a space where the entrepreneurs could be exposed to rapid ideation, positive critique, and beneficial connections with their fellow entrepreneurs. Through this workshop, I gained the opportunity to speak with more entrepreneurs about their interests and their experiences and learn about the types of concerns they bring to BIH to be addressed: to access the internet resources, to connect with other entrepreneurs, to find inspiration, and to speak on their own experience and lessons. After discussions with C-Level employees during this work both for my research and for their own activities, I learned that BIH sits within a growing innovation ecosystem that is learning how to communicate its purpose, develop its resources, connect to its other innovation actors, and facilitate Batswana-led innovation. Because there were so many different questions, relationships, and issues at hand, and as I only had a single perspective as an outside anthropological design researcher looking at multiple sectors of the innovation ecosystem, there was only so much that I could see and suggest as assistance.

I also learned that a critical question of this community **is learning how to determine social impact.** Because this question is so complex when it comes to innovation, and because I didn't want to assume that I knew what the correct evaluation decisions were, I instead wanted to present the community with the breadth of the field and its capacity, along with some specific approaches that might be of interest and some specific tools that the employees could use to support their own innovation decisions.

Figure 11: Delivering Invigorating BIH's Social Capacity: A Design Thinking Workshop.

To learn more, I also asked some managerial respondents if they would be interested in attending a workshop I designed, to probe their thoughts about some of my hypotheses and introduce a few evaluation tools that might help with their issues. I focused the workshop on broadening perspectives on evaluation to give the community some tools that could help them investigate what social impact they want to see.

While running these workshops and interviewing critical BIH stakeholders, I found how much of their activities are in their early stages. As the organization evolves and grows, it will develop further relationships, capacities, institutional knowledge, and resources to help their innovators. The BIH employees acknowledge this learning curve, and much to say about the process.

"The thing is, we're not going to know everything that everybody needs help with. As we go on, we'll acquire those resources...In the future, the spaces will shift even more, and the support capacities of the Innovation Hub will have to shift support as needed...I feel the newness will never stop. Even if you have your [educational] base, your business model, your business planning, entrepreneurship development, those things, what's going to change are the types of products coming in, and the support on those products."

"Here we have researchers, the scientists, the engineers, the designers. But, you also need the psychologists, the social workers, the other finance, managing, the marketing… those, we don't have here. The way that BIH is supposed to work, supposed to house technological innovation technologies, but they're supposed to know who is doing what where." Within that setup, the technology center, I should know where to get that from ease, so I don't have to order it from China. And that doesn't happen with ease."

"There's… a lot of information. But it's in silos and it needs to be coordinated. However, those relationships are being built, with certain organizations."

"That side, we're having a lot more conversation between us and LEA. Maybe because of personal contacts…"

BIH Employees

The organization is new, and the activities adapt and evolve based on the needs of its customers, the growing relationships it builds, and the evolving political dynamics that hold power over their operations. Moreover, it is still developing institutional and organizational capacity around delivering innovation that is beneficial to the country and the rest of the world. Much of the activities are still evolving and growing. A BIH employee also mentioned how the organization works to extend itself to help anyone who comes in, regardless if the interests are aligned:

"The thing is, we never tell people, we can't help you…. The first thing off the bat, is the referral system. If [your work is] not under our scope, there are still other entities that can help you develop your product."

BIH Employee

There are many advantages and capacities that are being built daily by the one-stop-shop that is the Botswana Innovation Hub. However, there is yet much to do to develop the institution, and the actors who have come in touch with BIH have opinions about its development. Though many sentiments exist, one can ask: **how do innovation actors feel about BIH?**

First, there are concerns about the public focus of the building. The policymakers and organizational heads decided to focus much of the resources and advertisement on the creation of a high-technology, top-of-the line building that rivals innovation centers in the Global North:

"We need to build unique innovations that we can sell to the world. To attract investors, we need to come up with the iconic building. We can bring up these innovators, can come up with the iconic industrial building"

External Consultant

This focus on the building, however, concerns many stakeholders as well. BIH entrepreneurs focus on the fact that innovation as an activity seems to be based on whether the building is functional:

"If the building is not yet arrived, does that mean that 'innovation' has not yet arrived?"
"It's a nice building. So, what? This building doesn't guarantee service."

BIH Entrepreneurs

Another concern is the limited presence of resources that would help innovators address some of the issues they aim to address when innovating. For instance, stakeholders have mentioned how BIH does not have, nor make available, statistics and research about innovation in the country:

"Information sharing is lacking...and research, in terms of actual knowledge. You should ask about actual facts, and actual data? How many patents? How many researchers, entrepreneurs, how many startups are in the country? You don't know. If you don't understand what the startups do, what kinds of linkages can we make for these local innovators?"
"They tell the stories, they are going through the same thing. They align some kind of comfort that they are going through the same thing."

BIH Entrepreneur

Another critical concern is that the BIH representatives are not fully aware of the political dynamics between existing innovation actors who have worked towards developing entrepreneurs in Botswana. In some instances, this is caused by concerns about who gets included in the BIH consultation and mentorship process, and in other cases, there is lack of understanding of what is required to develop an innovation ecosystem.

"[BIH] are partnering with Stanford, but They have not even invited [University of Botswana professors]!" We are well resourced. Why are they not [connected with us?] ...Can we work with you on the curriculum?"

UB Entrepreneurship Professor

"[There is a] disconnect between what the shareholders want. They are saying, bring us innovative ideas. BIH says, focus on the (five National Directives) you find that some of them aren't directly connected to those topics.

External Consultant

"[External supporters] don't see a clear path towards success… and there is concern. There's no large industry to be measured…This is a long-term vision of success. It differs according to different audiences, from a certain political perspective, it might not be worthy. The evaluation might have to differ when compared from the different communities] ...It's also, what do they see as important? I'm not sure...they see things as from our perspective."
"It's important that the stakeholders see what we're doing as important, or, that they're achieving what their expectations are."

BIH Internal Employees

"If only our government would understand what design is, if our policies support science, innovation, and technology…"

UB Professor

Ensuring that BIH becomes the one-stop shop requires that alternative leaders in entrepreneurship feel open to suggesting the resources the community offers to budding innovators. Also ensuring that potential resources, including professors, researchers, and administrative facilitators of entrepreneurship, feel like a part of the community will attenuate any tensions that exist.

Another concern is how in some instances BIH has not adequately advocated for startups to support their growth and development:

"How can we make the tendering process easier?... [BIH needs to] to be a policy advocate for innovators. We need the buyers in the room, local and external. They keep telling us, go out and find a solution to a problem. We have found them, and no one is buying the solutions to our problems. In the tender process Other people consistently had backing to support us, and others did….

BIH Entrepreneur

"From BIH, we have to ask for a recommendation letter It's a major boost, I would say.... To be associated with the brand. "

BIH Entrepreneur

Ensuring that BIH goes to bat not just for developing an interest in innovation, but for the specific needs of innovators when they are required, will ensure they develop clients, businesses, and track records. There is also concern that there is a disconnect between those that develop policy and manage the systems of innovation, and how they are unhelpful about the process they're trying to complete:

"You bring an officer into a landscape, they won't think like an innovator."
"These institutions should be open to a company to run it. Let's give it to a successful entrepreneur... If that guy started from the bottom, he will understand intimately in the local landscape, what will be done to push innovation forward."
BIH Entrepreneurs

"They think of rocket science, as opposed to starting from the grassroots, and then building upon it. My research is on cultural knowledge into product design. If I go and pitch, they despise that and say it's not innovation… I think here, we miss what innovation is."

External Entrepreneurs

There also are obvious issues and concern with the progress that is made in the innovation center; that the 'voice' is not clear and understood by the country.

"BIH is a 'voice' for innovation. How loud? Who is listening? What are they saying? Not sure."

BIH Entrepreneur

"Everyday innovation is improving and getting better...I have not seen anything yet that [BIH] has produced… yes, we have an innovation ecosystem, but how is this feeding the people?"

Local Entrepreneurship Authority Manager

As the one-stop-shop for innovation, BIH is striving to develop resources, relationships, and knowledge quickly to help support an innovation community that will hopefully bear fruit over time. In this process, growing pains are to be expected from a litany of stakeholders: the entrepreneurs supported and neglected, knowledge producers inside and outside the ecosystem, and policymakers who set the agenda and expect specific results. To be sure, BIH has a difficult job: managing expectations, developing resources, accelerating startups, and advertising activities for a topic like 'innovation' is a difficult endeavor in a country where innovation itself is a poorly understood topic. What can be said about BIH is how it must also grapple with being the designated cornerstone for shifting a culture. The institution is still in its early stages; how its culture evolves will determine the culture that it sets for the rest of the country.

Botswana Institute for Technology, Research, and Innovation (BITRI)

Figure 12: BITRI Logo outside Maranyane House.

"The capacity is THERE. The facilities have been built up, for the most part… we have nanotechnology labs [downstairs] you would find that is not as good in other countries…. The playing field has been leveled…. [towards these issues] I'm concerned about those people in the rural areas…. People first."

BITRI Board Member

Alongside BIH, BITRI is the other central institution that stakeholders generally mention when innovation is mentioned by the country stakeholders I came across. BITRI is the nationally proclaimed research and development flagship institution; as an even newer institution then BIH, however, it has even more it is trying to prove – and because its primary goals mention outcomes in 2020, it has arguably less time. The fact that the institution is up and running so quickly, however, reflects a strong national interest in supporting its success.

The Botswana Institute for Technology Research and Innovation (BITRI) is a parastatal under MoTE, established in 2012 to conduct needs-based research and development in desired areas of focus. The mandate of BITRI is to identify, develop and adapt appropriate technology solutions that provide sustainable and innovative solutions through co-creation and collaboration in line with national priorities and needs of Batswana. Situated at Maranyane House in Gaborone, Botswana, it has other campuses in Kanye and Palapye. BITRI has six departments; namely, Technologies, Natural Resources and Materials, Chief Executive's Office, Research & Partnerships, and Human Capital and Finance and Operations [128].

BITRI will develop technologies that will as much as possible maximize use of local materials to ensure efficiency and affordability. At BITRI, they are focused on three strategic priorities to be achieved by 2020: to develop one team mission, to deliver on six technologies, and to generate forty percent of their revenue.

BITRI was created from the development of two other parastatal houses: the Botswana Technology Centre (BOTEC), founded in 1979 [129] and the Rural Industries Promotions Company (RIPCO), established in 1974 [130]. The Public Enterprise Evaluation and Rationalization Agency concluded that the previous entities suffered from a variety of issues:

- lack of a proper research and technology focus,
- inadequate research skills,
- minimal research infrastructure and facilities,
- low research return / benefits on the use of public funds, and
- complete financial dependence on state funding.

Under the understanding that Botswana is a small country that has a limited research capacity, they merged two main research institutions, to keep these actors from competing for scarce resources [107]. BITRI was originally established not through its own Act of Parliament, but through the existing Companies Act of Botswana, which lets it become wholly maintained by the Government; many of the activities are reported to the office of the President to then maintain and report to the Batswana citizenry. To direct these new activities, a new mandate is suggested as to conduct needs-based research and development in focused areas of national interest, and to deliver high standard technology solutions that "maximise the beneficiation of local resources, through both institutional and collaborative programmes, to effectively and affordably address current and anticipated needs for sustainable socio-economic development [107]."

Those previous organizations' purpose, like BITRI, was to conduct applied research related to the development of the Botswana condition. To develop an understanding of the potential projects the institution would address, the BITRI office conducted a value gap analysis, which helped them determine needs that exist that could be developed with applied research. BITRI executives stressed the organization cannot be successful unless they serve the people and address their most critical needs. Therefore, the institute aims to reach the goals of developing high-technology products with a global reach, with commercial outcomes, and to address the present needs of Batswana. It is also influenced by the pressure on Botswana research to be considered as globally recognized leaders in their disciplines. To support this competition, BITRI's Centre for Material Science recently opened on July 13th, 2017 by the Minister of Tertiary Education Research Science and Technology, and aims to be a competitor in the field.

As BITRI evolved from BOTEC and RIPCO, many of the outcomes and resources from the institutions also exist in BITRI. For instance, projects such as the development of building blocks made from components from the Kgalagadi desert started initially in BOTEC [129], and offshoots of the project currently exist as commercial projects and further research in BITRI. As of this date, the technology is being rolled out at depots in the north of the country in twenty-nine separate depots, where the blocks are being manufactured and sold under the Poverty Eradication Programme [131]. The organization focuses on six separate categories: building materials, climate change, nanomaterials, technologies in electronics and communications, energy, and information systems and technology. The researchers work to develop projects that focus on a wide variety of issues, from development of decision support systems for dryland small scale farmers in Barolong and Kgalagadi South Sub-District, the development of affordable, simple to use point-of-use diagnostic devices for the detection of foot-and mouth disease virus (FMDV) and lumpy skin disease (LSD) virus, to the development of more economical and environmentally safer alternative power supplies for Gaborone traffic lights.

Another critical sector of BITRI is the design team, which aims to work as the connection point between the technologies developed in research laboratories and the people in the country. The design team speaks of how they engage in their research:

"We have the philosophy here that we are people-focused... we infuse co-creation. When we go into an area, we want to ensure that we co-create, and when we go into a place, we ensure we are together with our stakeholders."

BITRI Executive

"We have to make sure it is doing what you want it to do, when you must make sure it is safe. [We must ensure we allow] the person that you're developing the design for... allowing them to use the product. We must make sure they don't' let them feel afraid, so they have control over it... so that the user can use it comfortably.
It's actually very good to [involve end users in the process]. We usually get an honest response for what you're trying to do… when you get then from the onset, and focus on what needs to get done… sometimes you're going in the wrong direction…"

BITRI Design Team

What do stakeholders have to say about BITRI? As a new organization, BITRI does much work to build collaborations between organizations to benefit their capacity and resources. However, the relationships to be built are sometimes beneficial, sometimes laced with friction.

"BITRI we engage with each other, they invite [HRDC]. We are under one ministry… so we collaborate a lot."

HDRC Manager

"I don't understand this small politics. My last class in Innovation, I wrote a small letter, an email, to BITRI, to [talk about science, entrepreneurship, applied research.] They didn't come to just say 'this is what we do, and this is how we can inspire and motivate you."

UB Dean

At the same time, the organization has mentioned how it must remain flexible and adaptive. The political needs of the countries have taken the company in unexpected directions, and ensuring the community is open enough to develop resources to address evolving needs is a critical need:

> "As a [C-level executive], I never thought that [Foot-and-mouth disease] biology labs would be set up that soon.... But, as soon as there was a foot and mouth outbreak we saw an opportunity… here's a problem that the country has. We have the capacity to address this issue. We need to address it now! So, then we changed our program. FMD became one of our priority areas…. "We are generally are driven by our capability…"
>
> BITRI Executive

University of Botswana

Figure 13: University of Botswana Logo [132].

Though national policymakers have formed the innovation parastatals in the form of BIH and BITRI, the academic institutions of Botswana continue to play a pivotal role in teaching, research, and mentorship of innovation practice and institutionalization. As mentioned previously, all universities in the country also report to MoTE, so that the main science, technology, and innovation-based institutions can be adequately aligned in practice. As an innovation researcher, I first met the University of Botswana during IDIN activities, where I found that the lead facilitators found out about the IDIN community through the academic networks of the institution. To learn more about the mandates, activities, and evaluation approaches of innovation actors, I had to learn about the flagship institution and how its current internal resources support innovative activity.

The University of Botswana was established in 1982 as an autonomous University. Before then, it was part of the University of Botswana, Lesotho and Swaziland originally founded in 1964 to reduce the three countries' reliance on tertiary education in apartheid South Africa [133]. The mission of the University is to improve economic and social conditions for the Nation while advancing itself as a distinctively African university with a regional and international outlook. It does this by providing excellence in the delivery of learning to ensure society is supplied with talented, creative, and confident graduates, in advancing knowledge and understanding through excellence in research and its application, and in improving economic and social development by high impact engagement with business, professional practice of various types, government, and civil society. As the oldest public university in the country, the university holds the largest tertiary student population and most graduate degree offerings [134]. In 2016-2017, the University enrolled 15,146 students across various programs of study, where 73.6% obtained bachelor's Degrees and 19.2% obtained graduate certification [135].

The university supports a wide variety of activities in academic pedagogy, research, and community service across the country and abroad. The primary pedagogical activities that the university engages in to support student innovators are teaching and research. Two main branches support this education: the Faculty of Business and the Faculty of Engineering. The Faculty of Business gives students the opportunity to take undergraduate programs in Entrepreneurship and Enterprise Management, and the Ph.D. program leverages the Global Entrepreneurship Monitor to represent the country in one of the largest research consortiums in the world and intends to develop a Center for Entrepreneurial Development inside the Faculty of Business [136]. Students gain the opportunity to learn about entrepreneurship in their final year as a core capstone course. In Engineering, professors in Industrial Design and Technology facilitate learning at the Bachelor's, Master's of Philosophy, and doctorate levels. Deep experience in facilitating innovative practice exist in these offices, and tangentially in the many departments on campus. For example, the School of Industrial Design helped develop the curriculum and logistics for the International Development Design Summit, mentioned in future sections.

Many of the stakeholders involved in facilitating, practicing, or researching innovation acknowledge the foundation work the university has accomplished over the years, but have mentioned concerns about is present output. The main point of focus is how the main intellectual production – the research – should be more 'applied', which translates to having socioeconomic outputs apart from spreading knowledge in research articles and speaking at conferences.

"The academics are still about that publishing…"

BITRI Executive

"Progress is based on the number of journal articles...instead of an emphasis on research impact! [We need] to incentivize research impact."

HRDC Research Manager

Individual members of the innovation community had some ideas about how to invigorate academic researchers to benefit innovative activity:

> "To create a sense of value for them, the institutions. The impact may be equally as important as the publications. If you have more impact, it may create more publications. Because you might be able to take it from a technical base to a more contextual, sociotechnical context. And that enriches it… you're doing a value addition to this society.... you have a role to this society... For a professor, [you can ask] What is the meaning of your work? The publication is a step towards that end. Because where before the publication was the end, there is bigger more public role to make bigger, more positive change in the world. And we have to sell it for the work that we do."
>
> BITRI Executive

It was mentioned, however, that this not only the fault of professors. The institutions that determine academic success in the country require professors to focus on the 'traditional' form of success excessively, by only incentivizing academic production of knowledge through the development of research papers, books, presenting at conferences, and the like. This prioritization happens for early career academics on the tenure-track path and most disciplines who incentivize cultures of publish-or-perish. Moreover, certain actors make the case that the central government also enacts pressure to address this issue:

> "Those tensions are not just a question of actors, but of policy and structure…. The government says the focus of universities, is teaching, publications and community engagement. If that's what they say, then what can the university do? The actors and agents in that institution will ascribe to that rule. If there's no funding for research, then they will say no, [they will] look for funding from outside! It sounds realistic, but innovation has a cost. You got to fund Innovative projects. So, for me we have to see the role of governments in this…
>
> UB Entrepreneurship Professor

Innovation-Adjacent National Institutions

To ensure these primary institutions serve their purposes, there are adjacent national institutions that address a variety of other issues critical to a functioning innovation system. In no way is this list exhaustive; however, they each have resources that could be leveraged by the widely advertised innovation institutions and are also critical in understanding the national capacity in supporting innovation activity, and the obstacles they experience.

Local Entrepreneurship Authority

The Local Enterprise Authority (LEA) was established by the Small Business Act of 2004, Chapter 43:10 of the Laws of Botswana to carry out on behalf of the Government of Botswana, and more specifically the Ministry of Investment Trade and Industry (MITI), the mandate of entrepreneurship and enterprise development in Botswana [137]. The Authority's mandate is to promote entrepreneurship and small, medium, and micro enterprises (SMME) development by:

- Providing business development services through screening, business plan facilitation, training and mentoring,
- Identifying business opportunities for existing and future SMMEs,
- Promoting domestic and international linkages, especially between SMMEs and government, large business entities and other SMMEs,
- Facilitating changes in regulations, quality management systems and standards, infrastructure, and access to finance,
- Facilitating technology adoption and diffusion, and
- Promoting general entrepreneurship and SMME awareness.

Before the organization was founded, the country's landscape of small and medium enterprises (SMME) was "characterised by lack of a comprehensive SMME Development policy, multiple programmes and institutions." Per the 2016-2017 LEA Annual Report, the institution records 1463 Business Plans submitted across the country, 1282 entrepreneurs trained, and sixty-nine enterprises mentored. The institutions they develop include incubators in horticulture, industrial business, leather industries, sectors of manufacturing resources, partnerships with Botswana Accountancy College, the Department of National Internship, Botswana University of Agriculture and Natural Resources, Stanbic Bank, and much more [138].

An in-depth interview with LEA representatives mentioned how the organization sees its mandate, how it determines success, and how it interprets and consults on innovation activities. First, they work to become a knowledge hub for facilitating entrepreneurship in Botswana. They assist small and medium-sized entrepreneurs, and identify, validate, and evaluate opportunities to do business. They work to create employment and ensure those businesses are profitable. They also advise existing businesses, and advise government, to make an entire enabling environment for Botswana-based entrepreneurship. These activities, among other issues, were incentivized by problems of unemployment that plagued the country during its growth.

There is also the issue of high import bills. The government, private companies in the country, and its citizens spend a significant amount of money on the import taxes on good and services that could go towards locally produced businesses. Moreover, for each business that founded outside of the country and does business in Botswana, this has an indirect effect on employment; more people are likely to employ international people instead of Batswana. A further indirect effect is the entitlement funding the government pays on supporting food basket programs and related development interventions: each dollar a local business makes is one that LEA views as a dollar the government doesn't have to spend supporting that entrepreneur. By focusing on the concept of 'import substitution,' they aim to replace international economic activity with local activity.

The founding of LEA was also developed, like BIH, to facilitate the diversification of economic activities outside of solely the mining sector. With the development of core local sustainable businesses in the country, LEA assumes that 'chain effects' will occur through the service businesses: a company that employs five people would also hire taxi drivers, gas stations, grocery stores and restaurants, and other types of service businesses. To LEA, success is determining if they are addressing the mandates by meeting their desired targets: financial, economic, and human resources. Board members consult the capacity of the institution and the Botswana context, and come up with a yearly number of entrepreneurs and businesses they would want to support and develop projections on how much these businesses would potentially impact the GDP of the

country. They then list the successes of the enterprises they support and continue the process of supporting those companies as they grow. They gather information mainly by collecting the records from entrepreneurs they have connected with over the years about the survival rate of businesses (over a period of time, the number of businesses that are still running,) their turnover (or how much money they make,) and how many businesses there are. LEA mentions how this is possible because of the deep professional relationships they build while mentoring and consulting for their clients. These variables are used to track the presence of import substitution, and whether the economic activities might have rebound effects on indirect economies. They also collect information on when new businesses open, when new funding is acquired, and when employment changes at the company. After SMMEs graduate from the company, the LEA believes that most will collapse in four to five years, and they have been working to develop research and 'tracer' studies to determine what happens to businesses after years of facilitation.

The company also has an innovation and sector support consultation wing; as the Authority aims to conduct holistic support on the topics of interest including the market, regulatory issues, business grants and funding, they also consult on novel technologies, services, organizational structures, and services that entrepreneurs should consider when developing their business. They have offices that specialize in innovation related to tourism, manufacturing, and agriculture. By guiding the reviewers of submitted business plans and consulting the entrepreneurs, they ensure clients are well informed about their technological options when starting their business. This mandate reveals another main difference between how LEA perceives their relationship with innovation: they aim to consult on the new tangible technologies, structures, and services that would benefit the market, but they do not consult on *how those new technologies or markets would be created.*

Because the institution does consultation, research, and mentorship for Botswana entrepreneurs to facilitate their own entrepreneurial endeavors, I asked: **what is the difference between BIH and LEA**? The answer lies mainly in the types of projects that fall within each's purview. LEA is an older institution, developed during a different political phase that aimed to increase entrepreneurial capacity in the country, for the country. Many of the entrepreneurial categories they consult with relate to agriculture, leather working, and agriculture.

BIH, as was mentioned, focuses on the support of institutions that lie in the nexus of needs of the country and have the potential to advance further commercial outcomes of the nation, potentially in markets that are not yet exploited – or developed – to date. Secondly, the activities considered innovation aim to support markets that broadly serve populations outside of the country; due to Botswana's small population of 2 million, certain emerging markets that could take advantage of the country's economies of scale can't be served fully by the current society. These institutions are searching for businesses that deliver products and services to southern Botswana and the world that do not yet exist, while LEA is altogether local in their market, resources, and focus. However, the insights about the motivations, activities, and relationships built by LEA could build a foundation for what it takes to build a strong entrepreneurial catalyst.

Human Resource Development Council

Another relatively new institution is the Human Resource Development Council (HRDC), which has positioned itself as a tertiary education clearinghouse for the country. Established by the HRDC Act No. 17 of 2013 [139], the HRDC "provides a platform for the Public Sector, Private Sector and Civil Society to act in concert to drive the National Human Resource Development Strategy (NHRDS)." The mission of the organization is to "advise, plan, fund and coordinate the development of Botswana's human resource to achieve a knowledge-based economy by engaging and integrating stakeholders." Specifically, HRDC coordinates efforts by all parties to

- study Botswana's education and skills development mechanism,
- assess its impact on national priorities,
- identify barriers to effective delivery of the NHRDS, and
- mutually agree on targeted solutions that should be implemented in the short, medium and long term in alignment with the strategic intent [140].

When innovation is mentioned at HRDC, the primary entity inside the company assumed to be most aligned with activities is the Graduate Research and Innovation division, which facilitates the development of links between tertiary education and industry in the country. The roles and functions of the Research and Innovation division are to coordinate, promote, and support tertiary education and industry-linked research, to research capacity-building amongst tertiary education Institutions, and to strengthen graduate studies in the country [141].

HRDC representatives state that developing relationships between tertiary education and industry are critical to ensuring that research aligns with the economic and social needs of the country. The program runs a grant project to improve the competitiveness of Botswana's industry and generate the knowledge needed to transform it from a mineral-extractive to a knowledge-based economy. The Council intends to find opportunities to develop production resources that assist the progression from laboratory research to piloted and scaled-up technologies, while using the Technological Readiness Levels as a determination of technological capacity. The grant accepts proposals in the categories of Nano Sciences and Nanotechnologies, Materials, Systems, and Human and Animal Health [142]. A critical manager mentioned the importance of developing research mainly available to Batswana stakeholders:

> "We are exporting our knowledge. We have noted that, as a country, most of the journals that are coming out here are most cited, referred to, and used to benefit outside [the country], and we are not benefitting locally. We have yet to be developed in terms of intellectual property; in technology transfer, there is no link between the research done in the institutions and the industry. There is a gap. At HRDC, we want to close that gap."
>
> "We tend to make policies that are not informed by research evidence ...the government of Botswana, researchers, and practitioners…. The policies informed by expertise, experience, etc. but little of research evidence… so we need to make a pool of researchers at master's and PhD level."
>
> HRDC Manager

He also mentioned how many of the resources available facilitate researchers' abilities to support and protect innovation activity are inadequate.

"We are learning about closing the gap between our institutions… In Botswana, you will note there are little to no [technologies, startups, incubations] coming out of our universities. Recently I presented at the SARIMA conference our university-based technology transfer offices. "
"That was the challenge from the onset – it lacked entrepreneurship. It lacked technology transfer. It lacked intellectual property, commercialization... we are still grappling with these issues…. These are new terms we are still grappling with. [We are learning that] If you present your research before IP protection, you will not benefit from protection. We are still trying to inculcate the culture of people understanding intellectual property."

HRDC Manager

One focus of the organization is addressing issues related to unemployment, expressed as the Unemployment Bulge and the Skills Mismatch. Many stakeholders have mentioned how there are few jobs offered in the country, and additionally a mismatch between the skills the available jobs require and the skills the students obtain who finish schooling. This, among other reasons, is why the country mentions the 'bulge' of unemployed youth. When it comes to innovations, HRDC aligns with the activities in BITRI in aiming to support those with high education and access to knowledge-based economic resources – researchers, professionals, and entrepreneurs – to develop tools that could eventually blossom into new and unexpected economies. The manager mentioned the difficulty of this shift as well.

"Perhaps we are a country that relied on materials resources for quite some time. We have not taken heed of the need to move toward a knowledge-based economy. That is the reason why HRDC, is existing.... from a factor, to an efficiency – driven economy.... We need to balance supply of skills with labor market needs. That is the reason why we exist.

HRDC Manager

Companies and Intellectual Property Authority

As the turn towards a knowledge-based economy evolved, pressures to develop institutions that support the protection, advisement, and administrative registration of firms arose. To rise to the occasion, the Companies and Intellectual Property Authority (CIPA), established by an Act of Parliament in 2011, is mandated to register businesses and protect intellectual property rights through four acts:

- "The Companies Act (CAP 42:01), which provides for the incorporation of companies; registration of post incorporation returns and notices; monitoring of post incorporation returns and reservation of company names.
- Registration of Business Names Act (CAP 42:05), which provides for registration of business names and post registration notices such as change of ownership and cessation of businesses.
- Copyright and Neighbouring Rights Act, (CAP.68:02) which provides for the protection of the rights of authors, artists and creators, as well as protection of their literary and artistic creations, which are generally referred to as 'works'. These works include novels, poems, plays, films, musical works, and artistic works such as drawings, paintings, photographs and sculptures.

- Industrial Property Act, (CAP.68:03) which provides for the protection of industrial property rights in relation to patents, trademarks, utility model certificates, industrial designs, traditional knowledge, layout designs of integrated circuits, geographical indications and handicrafts [143]."

During the development of Botswana's economy, intellectual property was present as a concept, but it wasn't recognized or used as a tool for economic development. The country basically used the legislative Acts from South Africa and the United Kingdom and extending them into Botswana's purview. Over time, in 1996, they developed their own national intellectual property Act to build up their own legislative protection. The previous Act most recently went under reform in 2010, where the organization considered local and international trends, such as the protection of traditional knowledge. Today, this means there is very little understanding, capacity, and systemic support for facilitating the institution critical to Botswana-led innovation.

"[There is a] lack of knowledge and understand of what IP knowledge is...Education system have not channeled the capacity...UB only teaches an elective on IP law [and nothing else]. [The system has not been designed to think that you can pursue a career in IP. The industrial base is very low, [the skills are] based in specific industries...There are industries in the developed world that can absorb my skill. [Outside of Botswana], I can do laboratory research, and then people learn about IP, and they can go to school and become IP lawyers. [In Botswana], They don't know they can be patent attorneys. There is no market to absorb such knowledge."

CIPA Manager

In the country's Vision 2016 mandate, there was mention of the development of an innovative and prosperous nation; in developing a knowledge economy, critical stakeholders agreed that IP plays a crucial role in building knowledge and holding rights. Now, CIPA sees IP as a tool in economic development. Principal CIPA representatives mentioned that the intellectual property stakeholders are currently finalizing a new system that aims to protect, support and outline intellectual property of indigenous knowledge in the country. The main question asked by IKS stakeholders during this process is: when the use of the knowledge is commercially exploited, what recourse do the indigenous communities have? Developing these mechanisms around benefit sharing, consent, filing, and transparency are of critical importance. There a wide variety of stakeholders involved in the process, and CIPA works to ensure all viewpoints are included in the process.

Also included is how the policy protects against IP misuse. The current protocol, roughly, is as follows:

- First, the researcher or potential entrepreneur obtains prior informed consent with the community to use the IP. They can do it themselves, or the government can support as an intermediary.
- If the information is from a genetic indigenous resource, there must be a mandatory disclosure from the patent applicant that states that the entrepreneurs directly obtained the resource from a specific geographic site.
- There must have a contract between the user of the technology and the owners of the land that represents a benefit sharing agreement.
- Moreover, the policy must be strong enough to develop protection against different types of misuse.

- There is also interest in finding the IP, documenting it, and making the insights available so anyone will know if the intellectual property laws have been infringed upon.

The CIPA officer also mentioned why there was such a critical focus on ensuring IP laws were effective and enforceable:

> "Developed countries in the past weren't using IP systems, they took ideas from others. [Now that they've] brought in the IP system, it has hindered other country's ability to grow…. [It's] a battle of international trade."
>
> CIPA Officer

The officer also mentioned how there were previous instances where developing countries couldn't access medicines, or drugs because of the power of patent holders. In some ways, the pressure to establish intellectual property policy is not only to facilitate the country's foray into knowledge-based development, it is also intended as a form of protection. International stakeholders developed rules for idea exploitation that were not established in Botswana, and by the time the country learned about the consequences, it was too late. CIPA also mentioned that knowledge about the importance of IP in the country hasn't yet permeated; even today, the country received more international applications for IP rights than local applications.

More Actors in the System

There is a litany of other organizations that are involved in the evolving innovation system that support national innovation in various ways. For instance, there are many research institutions outside the programs at the University of Botswana that support the knowledge production the potential development of products and service that reach past academia. There are fifteen tertiary education institutions in the country, all listed in Table 6. Inside solely the University of Botswana exists six separate research institutions: the Okavango Research Institute, Centre for Scientific Research, Indigenous Knowledge and Innovation, the Centre for Study of HIV&AIDS, Centre of Specialisation in Public Administrator Management, and the San Research Centre [144]. Botho University has recently established an Entrepreneurship Hub also helps facilitate the development and mentorship in agriculture, ICT, and other related fields, and has developed relationships with the Youth for Technology Foundation to determine future outcomes. BIUST, mentioned below, has also held an Open Day to teach the capability of information and communication technologies to Botswana communities to help facilitate job creation, and offers a basic computing course to equip teachers with basic ICT skills to be used in curriculum delivery [145]. Each of these institutions has institutional and subject matter knowledge that can help benefit the development of the innovation system if harnessed effectively.

Table 6: Postsecondary institutions in Botswana [146].

Name of institution	Main disciplines or subject areas taught	Level of qualification(s)
University of Botswana	All academic disciplines including ICT, law, medicine and engineering	Diploma, undergraduate, graduate
Botswana International University of Science and Technology	Engineering, ICT, natural sciences	Undergraduate, graduate,
Botswana College of Agriculture	Agriculture, Food Science, Veterinary	Diploma, undergraduate, graduate
Ba Isago (University College of UNISA)	Accountancy, business, business law, management, ICT	Diploma, undergraduate, graduate
ABM University	Accountancy, business, management	diploma
Limkonkwing University of Creative Arts	ICT, creative arts, business	Associate degrees (diploma)
Botho University	Accountancy, business, management, ICT	Diploma, undergraduate
Tlokweng College of Education	Teacher education	diploma
Tonota College of Education	Teacher education	diploma
Serowe College of Education	Teacher education	diploma
Lobatse College of Education	Teacher education	diploma
Kanye Institution of Health	Nursing, pharmacy, dental care	diploma
Serowe Institution of Health	Nursing, pharmacy, dental care	diploma
Francistown Institution of Health	Nursing, pharmacy, dental care	diploma
Botswana Accountancy College	Accountancy	diploma

Another national innovation institution is the Botswana Investment Trade Center (BITC). Developed by the BITC Act on February 3rd, 2012, the institution consolidated the Botswana Export Development and Investment Authority and the Botswana International Financial Services Centre into a single entity. The purpose of the body is to promote, encourage and facilitate export development and promote, attract, encourage and facilitate local and foreign investment promotion in Botswana [147]. They do this by performing these critical functions: select and target investment promotion, effectively engaging stakeholders, facilitating effective investment, building a competitive and attractive business environment, sustaining export development and promotion, national image building and global awareness brand creation. The organization also offers target sectors towards diversifying Botswana's economy, including agriculture, beneficiation of soda ash, financial and business services, back office processing and call center services, automotive components manufacturing, leather, and cargo and logistics. The institution also lists a collection

of products developed through BITC-affiliated institutions, including Forma packs, aluminum windows and designs, latex male condoms, vinyl floor tiles, food cans, and cellular phones [148]. This organization does interact with and advertise the potential and activities at BIH, but the sectors, goals, activities, and knowledge of new markets would facilitate further exploitable innovation opportunities.

Another institution yet to be discussed that should be considered necessary is the Citizen Entrepreneurship Development Authority. As outlined in its Annual Report,

> "[CEDA] was established by the Government of the Republic of Botswana to provide financial and technical support for business development with a view to the promotion of viable and sustainable citizen owned business enterprises. CEDA was incorporated as a company limited by guarantee on the April 12th, 2001...in response to a recommendation made by the National Conference on Citizen Economic Empowerment (NCCEE) held in July 1999, in order to introduce the professional management of the Government financial assistance initiatives and to streamline the numerous projects providing similar schemes."
>
> "CEDA offers funding for capital expenditure, stock or working capital in new and existing business ventures. It also offers training and mentoring for new and seasoned entrepreneurs and business advisory services to entrepreneurs in various skills as identified through the needs assessment that is conducted during project monitoring [149]."

The CleanTech Programme that partnered with BIH also offers even more institutions in the country that can be used by fledgling innovators in the country:

- The Business Place, a one-stop-shop for support to startup companies,
- The e-nnovation Youth Empowerment Programme that offers support for young ICT entrepreneurs,
- The Botswana Development Corporation, that offers finance and business development support of bigger business projects, or
- Center for the Development of Enterprise, a European Union-sponsored global business and project development agency, which has a few CleanTech projects in its portfolio, such as Energy Efficiency projects [125].

Another related institution is the Southern Africa Innovation Support Programme, a regional initiative that supports the "growth of enterprises through knowledges, network and stronger innovation ecosystem." Originally set up in 2011, the three main objectives of the organization are to support: institutional development for regional innovation cooperation, innovation in enterprise, and inclusive innovation. Any of these organizations with certain resources for supporting aspiring entrepreneurs should develop relationships with these flagship innovation institutions to facilitate opportunities for synergy and growth [150].

The relationships, activities, focus areas, and outcomes of these actors are consistently evolving. Developing an up-to-date list of the entrepreneur resources, their activities and scope, and finding ways to better integrate these actors into the newly catalyzed innovation ecosystem should also be a priority of the flagship innovation community. However, as these institutions are being built from the national level down, further programs are working to catalyze bottom-up innovation – focused on the needs, capacities, and networks of the severely marginalized in the country. To learn more about the growth of this innovation community, we must become acquainted with a completely different hub: in the hot, sparse, unforgiving Kalahari Desert, where resources have been unexpectedly built to support participatory innovation practice. We aim to understand how in the subsequent sections.

Figure 14: D'kar Innovation Center.

"Africa has been innovating, but we haven't called it innovation."

BIH Entrepreneur

Though the country is slowly developing institutions to support innovation-based economies, the reader should not assume that innovation has never existed in Botswana. There are many of cultural qualities, knowledges, and experiences that aim to address complex problems in Batswana communities. Many innovation actors acknowledge this reality but mention how the ability to harness innovation and develop local markets today is still immature.

> "If you look at the entrepreneurial activity generally in the country, we are more into the necessity type entrepreneurship. Necessity type entrepreneurship is where you do things because you want to put food on the table, and there isn't much innovation in that… the car washes in the area, I see other car washes in the area, so I start a car wash...It lacks. They start because they want to put food on the table, they're not looking for any opportunities out there that they could turn into products or services..."
> "You can sell just a bit. You can sell and use for a daily basis. It's not improving their situation. If we had a number of entrepreneurs who were opportunity-based entrepreneurs, looking into the environment, looking for gaps, looking for what is lacking and solving a problem, or something up with a solution that would bridge that gap…"
>
> UB Entrepreneurship Professor

The Rural Industries Innovation Center and the National Institute of Development Research and Documentation at UB, developed a report that aimed to identify appropriate technological solutions that address pressing issues in Botswana communities. The organization mentions how developing locally produced energy technologies is difficult "because of how they are measured against similar tech in more industrialized countries but [developing independent technology is] critical to ensure that country develop resource self-sufficiency." The report also mentions how the locally developed technologies might be difficult to sell because: "Consumers of appropriate Technologies in the developing countries are also so choosy that sometimes they look down upon locally-produced products, not on the basis of output but merely on account of the technologies [that] have been locally produced [151]."

However, previous stakeholders have mentioned how local knowledge is an opportunity for developing innovation in Africa. The *Seed Innovate Africa* book, published by the African Innovation Fund, mentions the unique capacity of African institutions by describing hidden innovations and informal economies at its disposal:

> "The strength of African innovations, therefore, does not lie in cutting edge technology and high levels of private investment in [research and development], and neither in an entrepreneurial culture such as Silicon Valley. Rather, the strength can be found in the diversity and richness of culture and tradition – an incredible pool of inspiration. The Sankofa Spirit can help reinvent traditions as sources of modern problem solving, as ways of inspiring new products, new method of production, sources of supply, exploitation of new markets, and ways to organize business. In addition, we encourage what's been dubbed 'hidden innovation' which usually originates in informal economies, and might not seem obvious. In Africa, these tend to occur where real challenges off and produce real solutions [118]."

How can problems be solved in the community in tangible, actionable ways? How can anyone in a community with the aspiration to change it be set up with the tools to design solutions? Another international organization with worldwide influence is working to answer this very question; particularly, how useful innovation practice can extend the tendrils of locally-produced innovation practice. With a decade of international practice, the International Development Innovation Network (IDIN) leads in this pursuit, in Botswana and abroad. As a new member in this nation, I had the rare opportunity to learn about their practice and investigate how they determine success.

International Development Innovation Network

The first International Development Design Summit (IDDS) was held at the Massachusetts Institute of Technology (MIT) in 2007. Summits brought together diverse teams from around the globe to learn the design process and develop prototypes to address global development challenges, big and small. Originally incentivized by reframing the types of possible development outcomes from the traditional conferences, the organization has grown to become an international phenomenon.

The initiative lasted in whole from 2012 to 2017, as an initiative sponsored by the United States Agency for International Development, Higher Education Solutions Network (HESN). The program, which offered five-year grants from USAID to seven universities, was “designed to channel the ingenuity of university students, researchers, and faculty towards global development.” One of the labs at MIT stated its goal was “linking local innovators around the world who are using technology to address issues facing people living in poverty.” In its words, the local innovators often lack the support to take their solutions to the ‘next level’, be it at the home institution of MIT or the favelas in Brazil. The organization introduces people around the world to a collaborative design approach, and then connects them to a network of other innovators and an ecosystem of support [152]. Over the span of the grant, the IDDS organization to date has garnered over a thousand network members in over sixty-five countries and has run over thirteen international design summits organized by 200+ volunteers around the world, has reached 153 active solutions reaching 500,000+ people, and has twelve consortium partners in universities and other organizations reaching 6,900 design training participants. They have raised $3,670,000+ for funding post-IDIN, constructed twelve innovation centers run by IDIN members and their partners, and ⅔ of the network members go on to teach what they have learned about co-creation and design to others [153].

The main activities of the Network are the workshops they hold. They started out of International Development Design Summits. For the past eleven years, they have hosted two- to six week-long intensive summits where participants went through multiple iterations of design to develop tangible prototypes that aimed to address the local needs of an impoverished community. Moreover, to support their 'design by' activities, 'local trainers', usually whom are country representatives, engage in smaller, more frequent summits when they can, as supported by the IDDS experience, teach and aim to support smaller entrepreneurs in learning the MIT-developed design process in three to five-day experiences called "Creative Capacity Building" summits. The scope of the organization mainly focused on people, products, projects, and processes related to the co-design of technologies that benefit the livelihoods of people who live the diverse, complex, and marginalized experience of deep poverty.

The basis of practice in the IDIN network lies on the foundations of decades of cutting-edge development praxis. Because there exists in-depth research on both the practice and development of these activities, both in Kofi Taha’s “Creative Capacity Building in Post-Conflict Uganda”, and in Jessica Vechakul’s *Design for Social Impact: Two Approaches for Design Education and Design Practice* [154], only the aspects of the philosophy that are necessary for understanding this study’s needs are illustrated below.

"[Creative Capacity Building is] a methodology that was developed by MIT D-Lab and our partners to enhance people's creativity and build their confidence in creating technologies that can improve their lives and livelihoods. Creative Capacity Building began in the post-conflict areas in Northern Uganda in 2009. We had gone there with the intention of sharing some technologies that would help people with the transition from the IDP [internally displaced persons] camps to their villages, but what we found was that rather than a need for a particular technology, there was a need for something that would counteract the sense of dependency that had built up in the camps. In Africa, there are now particularly strong CCB programs in Uganda and Tanzania, and we have also done trainings in Zambia, Botswana, and Ghana. In other parts of the world, we have strong programs in Colombia and Guatemala, and we have also done trainings in Indonesia and the Philippines [155]."

As is listed on their website:

"Creative Capacity Building suggests that the underlying principles of co-creation and crowd-sourcing--typically applied to computer software development, corporate management, or high-end product design--can also be relevant to technology innovations aimed at ending poverty. This is only possible when the conditions exist for full participation in the entire design process by the people for whom these technologies are intended, which means investing in strategies that increase local capacity and support local innovation. At present, there are three main approaches to D-Lab's implementation of Creative Capacity Building: Village-level training; Community Innovation Centers; and the International Development Design Summit [156]."

CCB as a method was influenced by "a personal theory of practice and a practice of action that prioritizes confronting poverty-based suffering in the short-term over long-term economic or political interventions….CCB actuates our belief that development processes with technology at their center are most likely to succeed when they emphasize self-reliance over dependency, asset mapping instead of deficiency planning, local knowledge and skill-building rather than external expertise, and cross-pollination of ideas over one-way technology transfer." With this, the philosophical turn that guides the organization is asked by IDIN's founder, Amy Smith: "If the appropriate technology movement of the 1970's and 80's sought to address the question of 'what' technology should be promoted, and participatory development in the 1980's and 90s asked 'how' to best identify the technology a community wants, *CCB asks 'who' creates the technology* [157]*?"*

IDIN had a wide variety of activities it supported while it received USAID funding:

- Grants, including scale-up fellowships, microgrants (USD $500-$2000) and picogrants ($50-$300), which provide IDIN network members with funding and mentorship support to perform specific tasks that progress the development of their technology or social venture;
- The harnessing of direct human capacity to address their issues, including offering to match student or faculty-led teams to work on projects in the field, a mentorship program that can guide projects along the innovation pipeline, or space on a previous website-based MIT-based platform that connects Network members to a global network of engineers and businesspeople to address design challenges;
- The development of innovation spaces, including the development of community-led innovation centers, such as demonstration sites, makerspaces, or training centers, and the support of existing maker spaces;

- The facilitation and support of social media connection before and after summits and other IDIN-based activities through Facebook, Twitter, LinkedIn, Newsletters, and their personal online network Directory; and
- Funding and mentorship, to help participants organize future summits, to host an entire IDDS, to volunteer for IDIN, or to start an IDIN Chapter, for which they offered funding and mentorship [158].

The global IDIN office also supported, among other activities, a research office that aims to further understanding and knowledge in these topics:

- Local Innovation Processes and Ecosystems: Increasing our understanding of how local innovation works and how innovation processes and ecosystems can be described, mapped, and analyzed.
- Development Impacts of Local Innovation: Investigating the development impacts of local innovation, helping us understand why and how local innovation matters, and:
- Enabling and Scaling Local Innovation: Exploring the role that global networks play in enabling local innovation and spreading the development impact of local solutions and approaches [159].

IDIN in Botswana

Both sponsored as a virtual client of the Botswana Innovation Hub, and supported by its international representatives, IDIN aims to bring the benefits of co-design methodology, human capacity, funding, and international acclaim to ensure that San communities in the Kalahari Desert become a leader of innovation practice in Botswana.

The story of IDIN in Botswana started with a lone entrepreneur who became a part of the IDDS ecosystem as a part of the 2013 Zambia IDDS program; Thabiso Mashaba. His parent was a development practitioner and felt incentivized to contribute in the field as a result. While being a part of the Master of Development Practice program in the University of Botswana, he saw the IDDS program posted by a professor on an online forum. After participating in his first IDDS, he became motivated by its focus on expanding the capacity of design practice to address people's real-life issues related to poverty, and he wanted to see how the methods could assist with the many issues for impoverished folks in Botswana. Today, he sits as the head IDDS Botswana organizer, and works as an advocate for the cultural and creative industries in the country. Due to this work, he has acquired international recognition for the summits and his related startups and been featured in national news outlets speaking about developing San maker spaces [160].

Incentivized by IDDS, he then developed a relationship with the community in D'kar, in the Ghanzi province in Botswana. In 2015, one IDDS workshop lasting two weeks was run, and the head facilitation community decided they had the passion and resources to run another one in 2016. To ensure the 2016 workshop developed the resources necessary to support the extensive needs of the projects and international innovators, they harnessed resources to make a more sustainable innovation organization in D'kar.

He also worked with external consultants to train the community in collectively developing a business plan for economic sustainability of the Innovation center. In this plan they offer:

- Access to services, such as tools, computers, training, and information,
- Opportunities for economic development, including tourism, through innovation activities,
- Empowerment through the potential for employment and income generation,
- Sustainable cultural practice,
- Dissemination of information on San cultural diversity, and
- "Social license for return on impact" and return on investment for investors and donors [162].

The business plan suggests plans for selling goods, innovation ventures, CCB sessions, Tourism Build-It sessions, craft workshops, internet cafe charges, renting space, and small online advertisements. The plan also offers goals and methods of implementation, measures to ensure they reach these designated goals, a SWOT analysis for further investment in the workshop, a financial plan, a marketing and communications plan, the governance and stakeholder relationships the entity has built up until then, and risk management initiatives [162].

Moreover, the Steering Committee intended on building a complete IDIN Innovation Center in D'kar. Mashaba approached members of the Kuru Development Trust (KDT) to find opportunities to practice the work:

> "...In 2015, I was a volunteer in Kuru. There was a meeting going on between Kuru and Thabiso. We have a very good idea to start an innovation center, and you all have a lot of unused buildings. How is the center going to operate with Kuru? Are you going to be independent, or related? Even that is not clear today. Because we understood the concept, we want to embrace the innovation center. Because the focus is to create, it is very aligned with Kuru's vision."
>
> Kuru Development Trust Institution

Thankfully, the members found the building of the workshop was also aligned with many ulterior benefits: not only does it help keep D'kar community members busy, and equips them with necessary skills that can help benefit their lives, but also brings international experts, brings business to the rest of the organizations, and spreads interest and understanding of D'kar to communities that come on their behalf.

Mashaba has developed a robust international brand as a local innovation facilitator. They had plans to exhibit at the Innovation Prize for Africa Awards 2016 Activation Roadshow event in Ghanzi. The IDIN D'kar Chapter members had plans to collaborate with Ghanzi Brigade students and BIH FSVC innovators on several Social Innovation Projects, and they eventually pitched their innovations to members of the public at the IPA 2016 Activation Roadshow. The prototypes established at the Center were to be exhibited by team members at the IPA 2016 main event in June 2016 [162]. They developed a relationship with BIH by being one of the first FSVC graduates, with These Hands GSSE remaining a virtual member of the center. Their activities are widely advertised in brochures and magazines by BIH, including the IDDS 2016 summit. In the Innovation center, BIH provided the electronic resources: five desktops, three laptops, and the printer. IDIN financial supported the rest of the development of the center.

These institutions serve as the primary hub for the various innovation activities for the indigenous community, the innovation ecosystem, and Botswana CCB practice as a whole. By learning about these communities, I gained the opportunity to see how innovation practice was similar and different from the national institutions.

Seronga CCB Workshop

Back in the United States, I continued conversations with many representatives of the IDIN global office which facilitated organization, research, and evaluation, only to find we found a mutual project we were both interested in: evaluating the impact of the workshops. As an invited member of the 2016 International Development Design Summit, I had the opportunity to participate in a workshop a few weeks earlier – a CCB workshop in Seronga, a village in Northern Botswana. The workshop was located at a resort space on the Okavango River called Mbiroba Camp. The community drew a wide variety of members from many experiences together to learn how design practices can address this community's main issue: human-elephant conflict.

This CCB workshop, however, was a bit different from normal CCBs. IDDS workshops were intended to be the operationalized form of 'Design With', where a wide variety of international designers come together for week-long deep dives, and CCB workshop were intended to be 'Design By', where contextual, shorter versions of the workshops were held for country participants, by country participants. This workshop would hold a wide variety of stakeholders from the community context, from the national university, and from international locations – including me. However, the modified CCB afforded a unique experience; I had the opportunity to view the interesting dynamics between the different design processes, what projects are chosen, what outputs come of the workshop, and, towards the central theme of this study, how innovation communities evaluate. During the summit, I shared my time between all the different design groups and learned about the projects, the people, and their frames of interaction. I conducted direct user interviews, wherein I asked about the demographics of the people, their aspirations, why they attended the workshop, what they can expect from the solutions, and what they want for the future. The subsequent section outlines the context, activities, outcomes, and thoughts about the design activity to describe the culture, motivations, and outcomes of this workshop.

Seronga is a village at the base of the Okavango Panhandle. It is the regional center for some small settlements to the east along the northern edge of the Delta, as well as a focus for the people who still live in the northern areas of the Delta. Based on demographic data collected between 2011 and 2013 of the Greater Seronga region, it has a population of 2,879, an average household size of three people, an average age of 28.5, and the median of the population is junior high school educated [163]. There are six main ways that people in the region sustain themselves:

- Highly Paid in-migrated employees: They have high income from salaries of developed administrative centers, and they do not use arable land or natural resources.
- Low cash income households who rely on natural resource use: They are small and marginalized households, mostly with female headship. They neither crop nor keep livestock and have little access to cash income.
- Crop and livestock farmers: These are large farming households with long-established farms that possess livestock.

- Poor farmers: These Batswana have women at the head of their house. They have little cash from wage labor, and rely on natural resources for food and construction. They make up 60% of households in Seronga, most of the population.
- Local entrepreneurs with use and retail of natural resources: They possess livestock for wealth management but are not croppers. They make their living through business activities and collection and retail of natural resources by fishing, gathering, hunting.
- Local employees with livestock: They possess livestock for wealth management but are not involved in cropping. They rely on fixed employment for the earning of salaries, by investing in cattle [163].

Seronga is close to a Wildlife Management Area, and due to this, there are common agricultural crop damages and livestock death caused by elephants of the delta. Since 2013, the elephant numbers are continuing to grow, and about 30% of the crop yields are destroyed by their activities [163]. Ecoexist, the host of the CCB Summit, proclaims 15,000 elephants compete with 15,000 people for resources in an area roughly the size of Yellowstone National Park.

To address these issues, some expatriate researchers created Ecoexist, an NGO operating in the north of the country. Their mission is to support the lives and livelihoods of people who share space with elephants while considering the needs of elephants and their habitats. They do this by gathering social, ecological, and economic data to analyze the causes and consequences of human-elephant conflicts. In the short term, they empower farmers with practical, affordable, and effective tools to deter crop-raiding and reduce conflicts with elephants. In the long-term, they collaborate with local, national and international groups to create an enabling environment for a range of policies and programs that tackle the root causes of conflict [164].

The issue of human-elephant conflict is wicked in many forms. An Ecoexist executive described the problem as such:

> "Botswana hosts the largest population of elephants, and it's a very important resource, because tourism is very important to the country, and Botswana regions are protected areas. As a result, there have been good anti-poaching legislation developed, but the elephant population has increased over the past 20-30 years, and has come in from neighboring countries where they are being persecuted. Elephants also roam outside those protected areas. In some places, they share space with rural subsistence farmers who grow millets, sorghum, watermelons, to feed families.
> Now, they find themselves feeding elephants. [There is] increasing land that is protected, thus [there is] increased competition for space."
>
> Ecoexist Executive

The issue plagues a wide variety of activities for both elephants and humans: it impacts people walking to and from villages, people who herd cattle, and kids going to school. When there is a confrontation, sometimes elephants or people respond aggressively; both elephants and people have experienced casualties as a result. Moreover, the issue is described as a constant battle between two intelligent and dangerous animals; many solutions, like electric fences and burning smoke, have been effectively thwarted by elephants who fell trees to reach the crops. One activity they engage in is collecting the data about how elephants impact people's farms:

"I attend crop raids… what I normally do is we go into the fields which were damaged, and measure [how much is damaged.] Want to see the size of the elephant in that field…We measure the feet, and find if it is a mother, a father, how many elephants, if a family. [We] take that to our directors, and to the department of wildlife…"

Ecoexist Community Organizer

Ecoexist also has a hand in advising policy that benefits coexistence of the two communities. Examples include working with the community land boards to identify critical elephant and wildlife corridors, or habitats connecting fauna separated by human activities and structures. Recently, they obtained assurance that the board will offer land elsewhere if villagers live on the designated corridors.

Thus, many stakeholders were looking to find novel solutions to this difficult problem. Also, they are aiming to address the immediate needs of the farmers to protect their fields and themselves from social, physical, and economic harm. By ensuring the community focuses on a holistic approach, they aim to address the tangible issues of the communities, while searching for answers of the underlying drivers of the conflict. Moreover, Ecoexist built into their strategic plan how future solutions would come from interactive spaces of collaboration:

"Our Director is a lecturer at Texas A&M, they bring students there and they finish their PhDs, and it is like we are partners… and students coming from Botswana and Texas."

Ecoexist Community Organizer

"We had in our plan that we wanted to work with students that were involved in other disciplines, specifically engineering...to harness the ideas and skill-sets from disciplines [like] engineering and computer science, to come up with new ways to address the problem…. We wanted to give students a challenge through competition."

Ecoexist Executive

The founders of Ecoexist are adjunct faculty at the Texas A&M University (A&M)'s Center on Conflict and Development (CONDEV). A&M, as another member of USAID's HESN network, developed a relationship with IDIN at MIT during an annual laboratory director meeting, and they found an opportunity to turn a summit into a collaboration:

"Amy's interested in Botswana, when I told her about our projects in Northern Botswana, she wanted to find a way to support. She invited me to the CCB in D'kar, then I brought her up here and introduced her to the [local NGO representatives], to Ecoexist...we've been planning this for the last year and a half."

A&M Professor

As there were great opportunities to leverage the CCB methodology into future collaboration with a wide variety of stakeholders, there were many interested parties who participated. This included local farmers who were representatives of their villages, Ecoexist community members, Ecoexist Directors, Texas A&M professors and students from engineering, the Bush School of Public Policy, and education, a student from the University of Stellenbosch, professors and students from Industrial Design at the University of Botswana, a representative from USAID in the South African Development Community, some CCB facilitators and organizers from MIT, and some family friends of Amy Smith, and a lone researcher from University of California, Berkeley.

The projects by the communities were related to the needs of the stakeholders who live in the community. One potential locally-bred solution was to appeal to elephants' smell; they have noses that are many times stronger than humans, and their sensitivities can be used to the villagers' benefit.

"The method we use, we burn the chilis around the [farms]...when the chilis burn, there is a smoke that goes into elephants' nose."

Ecoexist Community Organizer

Thus, three projects aimed to better utilize chilis in some fashion to keep elephants away from humans, farms, and crops. They were developing dung ball burners, technologies that dip rags and ropes into a water-chili solution, and a chili crusher technology that keeps the chilis from entering the eyes, nose, and face. There was also a project that aimed to brainstorm new ideas for protecting crops from porcupines and a project that makes a corn stock mulcher to benefit the community soil.

The workshop goes through multiple sessions to teach design to the participants: design theory, critical woodworking and metalworking skills, principles of teamwork, prototype development, and community presentation. They ask the colleagues to trust the process, and unique dynamics arise from this experience. There is also time allocated during the workshop to ensure the team facilitators also understand the culture and activities they create for their teams. Before teams break out into their projects, design representatives who are sufficiently knowledgeable about team management and design are all primed on the important qualities of making these international, intergenerational, diversely experienced teams successful. The facilitators make sure the participants are enthusiastic, they practice respect for cultural differences such as language and food, and daily expectations are managed about what they will accomplish during the design process.

During the CCB process, the facilitators suggest the participants focus on the process of design, instead of the product. For instance, during the metal-working skill building workshop, the community was taken through the process of making metal corn shellers useful for quickly sucking kernels, and during the woodworking section, all design participants created their own tables from scratch. Participants also learn a specific form of collective brainstorming, where the teams collectively come up with an idea and the group builds off that original idea for a minute or two. By offering useful opportunities to collaborate, the groups develop opportunities to be creative and show the participants how those methods are useful in the design process.

The groups then take time to listen to the experiences of the Seronga representatives to learn more about the design problems in this particular CCB – in this example, dealing with human-elephant conflict. The rest of the group interview certain participants, and design teams visit sites of outside villagers who are currently being plagued by these issues. An example is a community who had their electric fence trampled. This activity gives space for valuing lived experiences as useful expertise for these communities. The workshop offers multiple methods to determine collective understanding. In some examples, they just spoke to the communities; in others, they drew a map to learn about the villagers' location; still others they created a quick model of the technology before or during the interview to gather an understanding of the context. These types of open opportunities for data are incentivized in the CCB design process.

During these activities, the community also leverages opportunities for informal teaching moments. In these instances, stories about the power of simple design are used to teach how everyone can design to solve simple problems. For instance, CCB facilitators recalled the story of a man who needed to use a machete to hack through grass as he moved from place to place. However, the grass stayed in his face because the machete was too small. Instead of buying a new longer machete, he built an extended handle on the one he already had, which addressed his problems. These stories aim to teach how many simple problems can be addressed by personal design, and the people most influenced by the problem likely have most of the knowledge about what needs to be done to address it. Another example arose when the community saw a power drill brought by the IDDS facilitators, and they asked if they could demonstrate how it was used. There were no plans to do so originally; but the fact that it was there afforded the opportunity for the community crowded around to learn and practice that alternative making skill.

It was also mentioned how critical it is for everyone in the workshop to be active during the workshop. In certain design teams, there was a concern that men would commandeer design spaces: opportunities for discussion, making and prototyping, and decision-making. Ensuring the facilitators are cognizant of these potential tensions and ensure all communities participate in each part of the workshop is also prioritized.

Figure 15: CCB Seronga Participants from Ecoexist.

Goals of CCB Participants

As a researcher intrigued by the collective and individual goals of this workshop, I leveraged the design space to learn about the many various goals the designers brought to the workshop.

"That's why Ecoexist is here, that's their goal, is to help alleviate human elephant conflict, and live in coexistence, and celebrate the people who live here... It's difficult to live with elephants, and where do the benefits come... to really maximizing the potential for positives for both animals and people. And I want to help support them with their goal."
"If one of the solutions is one of gamechangers for communities, helps make life easier, helps protect crops, and really promotes coexistence."

A&M professor

"Funding in Africa is a bit of a problem, we're hoping Texas brings stuff, hardware, tools [to benefit innovation] ..."

UB Student

"[I came here to] find new techniques for doing a project I want to do. All of the information you can come up from those guys: The practical, and the theory. The goal is what I learned in the workshop. I already know that this is useful"

Ecoexist Representative

"…we need to collect data on making a case for something like [CCB]... [A&M Professors] need publications. So, if we could flex data that can serve multiple purposes, making the argument at our home institutions…"

A&M Professor

"I want to support people's ability to not be dependent on white people to come and solve problems. [Africa is] handicapped by their dependence on foreign aid…"

UB Student

"How can I manage expectations when working with community people? Are the communities expecting something at the end of this? When you work with them on a day-to-day basis, they have their own expectations. How can one manage those expectations?"

UB Professor

"[We want] a solution to the porcupine problem… keeping the porcupines out of the field to make the crops safe [for the community design participants]. [We want to] create an innovation that would be a kernel to be developed into something better…. Not an actual, but a more aggressive solution... Even having that, that little bit of change… little is good."
"[To have Seronga community members] be able to create a sustainable economy, for their own ideas."

A&M Students

"I don't expect to change everything about their culture...it'll be little things. Like when a lady comes in with her idea, they won't immediately write her off."

CCB Facilitator

While many of the dynamics exist, many representatives acknowledge how power dynamics exist in this space of development practice. These participants believe stakeholders are directly influenced by the problems are those who have the most to gain, and thus their goals should take priority.

"[The community farmer] groups are the ones most passionate about their solutions they want. [Ecoexist community leaders are not] the ones in the fields, but they are affected as well. The role that I thought I was going to play as a student... because come on. This stuff isn't going to affect us, We're about to leave in a couple of weeks…whatever. I thought we were gonna be the ones who were gonna help make an idea happen, to be the conduit…the women farmers have the highest stakes, they have to most to gain, and the most to lose…If they don't do this, they're not gonna eat."

A&M Student

"You can tell in the presentations, on day five, we're going to present the ideas to the larger groups You can tell based on their presentation how they feel about the project."

CCB Facilitator

Moreover, I asked the many participants questions about the future potential outcomes of such a unique design workshop. **Many of the CCB participants came because of their personal interests, and their visions for success of the workshop connected to their positionality**: their personal goals, the institutions they represent, their future career paths, and opportunities those present relationships afford. For instance, A&M brought along professors and students connected to the Aggies Invent program, a 48-hour intensive innovation experience for thousands of A&M students a year to address design problems by industry and social impact institutions. There is a presence to focus the project internationally, and being a part of a CCB gives the professors the opportunity to learn if there is organizational alignment between the methods:

"We would watch to see how this goes...this is not the scale of how we would do this. We got 15,000 engineers, and we want as many as possible to have international experiences. [I] work for innovation and entrepreneurship, we're trying to figure out more ways to get more engineers out in the field... because engineers will spend time making things no one will need. [We want] to get them practical experience…. We think it's important to have a global perspective."

A&M Professor

Another participant, the representative from USAID SADC, came to the workshop expecting and contributing very little but found a workshop that completely shifted his worldview. He works on policy development issues of natural resource management issues in the upper Okavango river basin in Namibia, Angola, and Botswana. Their primary work is in Angola, as the source of the water for Seronga is from that area in the country. The Angolan population is expanding, which leads to soil erosion and other resource-impacted issues. As a result, his office works to preserve the life of the Okavango River and its people. Though USAID SADC doesn't financially support their work, the executives of Ecoexist invited him to see the novel experience of a CCB, to learn from their novel experience of design. What CCB showed him made him rethink the possibilities of interdisciplinary work.

"We [normally] need to engage with the relevant people to put a plan together...Ministry of Agriculture, or determination of Environmental Affairs…"All the design is participatory, that the people impacted by the idea are a part of the design process", make sure local institutions are established, [such as] natural resource governance structures… if there aren't any, we make them…That's not enough. We need to reach out to other sectors we're not even thinking about."
"We're putting together our 5-year plan...In October 2016 there will be a new strategy for the next five years, [we are establishing] where we want to fund the next five years... Hopefully, I want to put [this] into the strategy, our consultation. I hope it happens.

USAID SADC Representative

CONDEV also was planning on telling the story to advertise the types of projects students of the program work on daily. A student who worked as an intern in the CONDEV office was brought along to be able to report these activities to USAID's HESN program on their website, so the story could be used to recruit new students and attract similar programs to the CONDEV community.

These insights reflected the fact that there were a wide variety of aspirations, experiences, and roles to be filled, which influenced the goals these communities had for success. It is understandable that the different stakeholders all had different goals in this space of innovation practice, and that the IDIN facilitators had the most influence on the goals that were eventually reached and how. The MIT collaborators had worked tirelessly to develop a CCB methodology, logistical plan, and facilitative experience to develop a variety of useful outcomes, where they developed institutional knowledge about the goals their workshop could attain. Moreover, they facilitated a space where the rest of the community members had to put faith in the CCB process; this meant they also had to put faith in the potential outcomes of the workshop.

However, another critical consideration is how the IDIN community had to simultaneously manage the expectations and goals of the coming group members. Many of the workshops participants mentioned how at the beginning of the workshop there was miscommunication about what would be accomplished at the workshop and by whom, and the communities had to come together to redevelop trust, and a mutually beneficial solution. This, and the presence of the many goals in the workshop, **outlines how the goals of the stakeholders don't have to be the same, but they should be aligned** in some form or fashion.

The Context of the San in Botswana

To understand the innovation activity at the 2016 Botswana IDDS, we must understand the situated context of the development intervention. As we learn more about the history of colonization, exclusivity, government policy, sensitivity, empowerment, and interventionism, we can understand and tease out the qualities of the IDIN network that are genuinely unique, others that mirror the history of D'kar, and how the IDDS community must navigate these contexts while facilitating their workshops. We first cast our eye towards the history of Botswana experience with the San.

There are few people that are more well-documented in anthropology and related fields than the San communities. For instance, after collecting over 3,000 samples and after identifying fourteen "ancestral population clusters," or groups of populations with common genetic ancestry, genetic anthropologists came to the conclusion that the origin of human migration is in South-Western Africa, near the coastal border of Namibia and Angola – the homeland of the San, based on the widely-accepted theory that the highest level of genetic diversity is in the oldest population – the one that has had the longest to evolve [165]. Other studies found that "the ancestors of the Khoisan, hunter-gatherers living today in southern Africa, began to split off from other living humans about 200,000 years ago and were fully isolated by 100,000 years ago", and that our ancestors might have already evolved behaviors seen in living humans, such as language as early as that split.

The more recent experience of the San in Southern Africa is a complicated story that must be understood by outlining the tense and complex history. The best illustrated narrative of this relationship between the Nation of Botswana and its San community comes in the form of Sidsel Saugestad's *The Inconvenient Indigenous,* published in 2001[100]. He develops an exceptionally in-depth ethnographic narrative of the sensitive relationship between the Botswana San and the national government, through *the Inconvenient Indigenous*.

As Botswana has developed economically, Saugestad mentions how the country has earned a reputation as a 'shining example of democracy' and is often described as ethnically homogenous. The Botswana Constitution adopted at Independence in 1966 guarantees the "Protection of Fundamental Rights and Freedoms of the Individual ... whatever his race, place of origin, political opinions, colour, creed or sex." In the light of South African Apartheid and over the decades of tribal conflicts that have rocked other nations, it appeared to be a wise call. However, this decades-long policy has deleterious effects:

> "In this process, 'ethnicity' has been linked to 'tribalism' and has been seen as anathema to unified national development. Botswana has chosen to elevate the culture and language of the numerically dominant Tswana people to a new national, neutral standard. In effect, this 'Tswanadom' has become the dominant symbol for the whole Botswana nation, and has been presented as the image of a non-racial, culturally homogeneous state [100]."

In this outlining of "a unified and unitary nation-state out of the diversified Bechuanaland Protectorate," the San have been left behind. However, Botswana is not unique in this regard: The San experience complex marginalization in all six southern African countries they engage with: South Africa, Botswana, Namibia, Zimbabwe, Zambia, and Angola. Residing today in six countries in southern Africa (see Table 1), the situations – including those involving human rights -- facing the San today are diverse [166].

Saugestad further outlines the historical issues why the San were rendered landless, voiceless, marginalized, and cut off from the resources they sustainably utilized for years.

> "...the British practised a policy of non-interference, or indirect rule. This meant that the changing fortune of the San population was determined by their relationship to the dominant groups in the country, and this relationship was very little modified by colonial rule.
> Although the farms were established in San territory, the land was regarded by the colonial administration as terra nullius, i.e., vacant land with no legal owner. The early European settlers sank wells but did not fence their lands, using Bushman labour instead to protect their livestock. Thus the mode of land tenure

> employed by the early settlers was 'inclusive' in the sense that in addition to the rations the Bushmen received in return for farm and domestic labour, they were allowed to hunt and gather on the farms. Remaining land was appropriated as Crown Land according to an Order in Council of 1910…. Since the reserves excepted from the definition were delineated mainly for the Tswana speaking tribes or communities, the Crown effectively claimed title to land belonging to Basarwa, Kgalagadi and other voiceless minority groups who were not incorporated into the recognized Tswana tribes or territories. The 1910 order can thus truly be regarded as the first legal instrument to legitimatize the dispossession of minority ethnic groups.
>
> In 1959, the country's central administration, which was still under British control, converted the system of land tenure with respect to the Ghanzi farming block from leasehold to freehold (Sanders 1989:115). New ranches were meted out, and by now it was a condition for sale that the purchaser erect boundary fences, thus gradually blocking Bushman access to their former sources for subsistence [100]."

Issues with land ownership didn't end there. Tc'amnqoo, the ancestral lands of the San, was declared the Central Kalahari Game Reserve (CKGR) by the British colonial administration in 1961. After independence, things did not get much better for the San. There are extensive reports that things became immediately difficult once the Botswana Government came to power; social services had been developed in the new town of Xade but were eventually discontinued. Decades of relocation, resistance, and building tension occurred between government institutions and the San in the CKGR. In 1975, the Tribal Grazing Land Policy (TGLP) was enacted to "combine environmental conservation with better range management and increased productivity" by mandating cattle grazing and conservational practices on their own land. However, the subsequent years showed that the San, who had fewer cattle and fewer resources for consultation, were practically excluded from all implementation and consultation activities [102]. The district commissioner declared at a Ghanzi Land Board meeting in March 1977: "All this discussion and planning is getting in the way of development. Bushmen, if they are in the way, should be simply gotten out of the way, so we can put up our fences [167]." In 1997, many representatives gave up resistance efforts and were relocated. Survival International, an international organization that advocates for indigenous rights, called for the boycott of Botswana's diamonds because of the severe marginalization of the San, and the government banned several human rights activists and reporters from entering the country. Eventually, after decades of experiencing the harrowing consequences of relocation, the organization the First People of the Kalahari filed a court case against the Botswana government in 2006, the longest and most expensive trial in Botswana legal history, through which they eventually won the ability to reenter the CKGR [1].

As these land woes evolved, Botswana aimed to develop plans to support the deeply impoverished in a variety of ways. A few years after the roar of independence died down, the Bushmen Development Programme was started in 1974 to do the following:

> "This project aims to foster the self-reliance and development of Bushmen citizens, and to facilitate thereby their great(er) integration with the wider society of Botswana. It will achieve this in two main ways: Firstly, by ensuring that existing rural development projects for services, facilities, opportunities and assistance are extended to this largely extra-rural sector; secondly by implementing a number of new projects, designed especially to cope with the particular problems unique to Bushmen citizens."

This program eventually evolved into its successor, the Remote Area Development Programme (RADP), for a couple of reasons:

"... the need for Bushmen Development (by 1976 changed to Basarwa Development) was based on a view that the general strategies for rural development did not reach Basarwa or other nonvillagers. The rural development policy was based on (a) conventional large population agglomeration approach, (i.e. the larger groups the people live in, the more services and facilities), and was (b) biased towards pastoral economic activity [100]."

The guidelines for the Economic Promotion Fund (EPF) from 1989 are much quoted, and they characterize Remote Area Dwellers as those who 'tend to' lie in a variety of indicators: those who live outside village settlements, who live far from basic services and facilities, who fall outside the scope of other national development programs, who are poor, who rely on hunting and gathering for their livelihood, who lack livestock, who have difficulty acquiring land, who have no water rights, who are culturally and linguistically distinct, who have a low level of literacy, who have egalitarian political structures, and who are politically silent [100]. In this description ethnic delineations are not used, but these indicators describe San conditions.

Today, there are a wide variety of poverty-alleviating interventions in which the government invests to this day. The government lists in 2012 twenty-three poverty eradication strategies that beneficiaries can choose from, from participating in backyard gardens, bakeries, backyard tree nurseries, beekeeping, fashion design, fish farming, food catering, hair salons, beauty salons, home-based laundry, jam making, vegetable pickling, kiosks, landscaping, leather processing, packaging of food grains, small stock, tent hire, phane (a traditional Tswana food), bottle recycling, fire beaters, basketry, and child care. There are other resources as well, including the aforementioned CEDA, which targets citizens interested in small- to medium-scale businesses by providing them with business training, finances and expertise to start and sustain businesses; the Ministry of Education and Skills, which plays a key role in sponsoring needy children from formal school to tertiary education, non-formal educational interventions, supporting the Ministry of Health on HIV/AIDS prevention, care and support, maternal and Ministry of Education and Skills development of non-formal education (National Literacy program and post literacy) and livelihood training, among others; and the Botswana Housing Corporation, which builds houses for the Self-Help Housing Agency [168].

RADP operates as established in Hitchcock's "We Are the Owners of the Land': The San Struggle for the Kalahari and Its Resources":

"[In 2006], The Remote Area Development Program currently operates in 7 districts in Botswana (Central, Chobe, Ghanzi, Kgalagadi, Kgatleng, Kweneng, and North West (Ngamiland)...[The program employed several strategies] to see to it that the needs of remote area populations were met…(l) the carrying out of careful population surveys and consultation efforts, (2) the implementation of adjudication procedures, (3) the setting aside of land for people within commercial areas, (4) dezoning areas where there were land use conflicts, (5) adding appendices to the TGLP lease, and (6) promoting diversified development activities in communal and Wildlife management Areas [168]."

This focus on addressing poverty is also present on today's political stage. Most of the funding allocated in 2018, at 5.80 billion Pula, funded poverty eradication schemes and destitute housing construction for the low-income groups [105].

Saugestad states the official justification for the support to Botswana's Remote Area Development Programme was that "the programme was providing benefits to poor and marginalized people, and the program was categorized as a case of 'poverty alleviation'. To understand the preference for this label we need to consider again the particular situation in Botswana." The complex dynamics which cause the tense relationship with Botswana's government were made ever tenser by Botswana's Minister of Local Government, who controversially answered the question about how the government would decide to treat the situation of their San:

> "The Government has not planned any programmes or activities in commemoration of the international year of the indigenous peoples, which is 1993, in terms of a United Nations resolution. This is because, as far as we are concerned, all Batswana are indigenous to the country, except those who may have acquired citizenship by registration. In addition, [the] Government's development programmes and assistance schemes do not draw any distinction among the country's citizens [100]."

This quote hit on the unique issue of how the Botswana government defines their San. Saugestad expressed how indigenous researchers and activists worldwide had reached consensus regarding a definition of an indigenous peoples. They are (1) the first to arrive in an area, they are (2) placed in a state structure with social and structural characteristics alien to theirs, they are (3) a minority population, and are not the controllers of the national government, they (4) have culturally adapted to resources and territories in ways that diverge from the present majority, and they are self-ascribed as indigenous. This context makes the dynamic of Africa and Botswana especially tricky, where with respect to colonial forces, all native Africans experienced these qualities. Due to this complication Saugestad poses an analysis that offers reasoning about the inadequacy of poverty-focused interventions in Botswana:

> "On the one hand, the Basarwa may be defined, as in the stated policy, as a group characterised by absolute and relative poverty. ... On the other hand, a different, but equally relevant approach would be to stress the fact that the people in question belong to a marginalised ethnic minority, making up the indigenous people of Botswana. Being indigenous denotes a structural position for a group of people whose main characteristic is a lack of influence over the workings of the state, and therefore also over their own situation, and it is often accompanied by discriminatory attitudes from the majority population. Both approaches provide a reasonable understanding of a social situation. Moreover, both approaches identify roughly the same group of people, on the ground. The two approaches may be seen as alternative, and in some sense complementary, interpretations of a complex reality. But as interpretations, they also direct the attention towards alternative strategies for changing that reality. The potentially beneficial impact and effect that is the objective of a given development programme, will depend on the definition chosen. Belonging to a marginalised, often stigmatised, indigenous minority almost invariably includes a state of abject poverty. However, changing the situation calls for remedies of a more fundamental and radical nature than what can be expected from a welfare programme. **Welfare programmes directed towards indigenous minorities often increase dependency, instead of reducing it, since aid is directed to symptoms rather than to the underlying causes of poverty** [100]."

Saugestad concludes that "the RAD Programme, in its effort to be culture-neutral has become culture-blind [100]." Moreover, the case has been made in a wide variety of contexts that the government's acts have overall harmed the San – notably, the activities related to relocation. Hitchcock, Beisele, and Lee in Hitchcock, R. K., M. Beisele, and R. Lee. "The San of Southern Africa: A Status Report" briefly outline much of the history of land issues concerning the San in Botswana since independence:

"The Central Kalahari Game Reserve, the second largest game reserve in Africa, was set aside in 1961 for purposes of protecting habitats and the people that utilized the resources and lived in the region for generations. In 1986, the Botswana government decreed that the people of the Central Kalahari Game Reserve had to move out of the reserve. This event set in motion a whole series of efforts by Central Kalahari residents and support groups to try and get the Botswana government to reverse its decision. A Negotiating Team of CKGR residents and supporters was formed in 1996 and attempted to engage the Botswana government in discussions about the future of the CKGR, to no avail….

By early 2002, nearly all of the residents of the reserve, who had numbered well over a thousand in the 1980s, had been relocated by the Botswana government and District Councils to two large settlements in areas on the periphery of the reserve. There the resettled people were eking out an existence and living on government rations and what was left of the compensation payments that they had received….

In 2003, the Minister of the Ministry of Local Government of Botswana, Margaret Nasha, discussed the issue of land rights under the new land policy in the country. She categorically rejected the idea of San having special rights different from other citizens of Botswana, and said that the San have the same rights to apply to the Land Board for land as other citizens do.

The Tribal Land Act Amendment Act (1993) made it possible for people to get land anywhere in the country, not just in their home districts. This is fine, except for the fact that the only people who can afford to apply for land in another district, which they then have to develop in a two year period, including providing water and fencing, are people with substantial means. What this means, in essence, is that those people who do not have sufficient capital cannot afford to obtain land in districts other than their own….

The San who apply for land in these places often have difficulty getting business licenses, whereas other people, who are not San, seem to have little trouble. What this means, in effect, is that San are treated differently by Land Boards on the basis of their ethnic background, which is illegal under Botswana law….

San, when they apply for water rights or for grazing rights, usually do not get the water rights or land rights allocated to be them by the Land Boards [166]."

As these complex dynamics of land and resource rights have evolved, so have the strategies the San have employed to reacquire those rights. Many elements of this struggle are represented in Hitchcock's *'We Are the Owners of the Land': The San Struggle for the Kalahari and Its Resources*.

"By the end of the millennium, San had relatively little land left in Botswana. The only areas set aside for San were the Remote Area Dweller settlements, which, by the end of the millennium, covered a total of 3,523 sq. km, or 0.6% of the country….As of 2005, there were over a hundred communities that were engaged in organizing themselves as representative and accountable management groups and were attempting to get themselves registered officially with the government of Botswana as legal entities [169]."

As is explained previously, the "San have land and resource rights as citizens of the countries in which they reside may be true in principle, but in practice these rights are often not observed by governments and local authorities." Secondly, they collectively realize that the international community will not be able to have much influence in terms of getting the Botswana to agree to ratify indigenous peoples' rights or implement policies that assist these communities based on indigeneity [169].

Moreover, the contentious relationship between advocacy organizations over the years has developed into historical tensions between existing international actors. Survival International, which has been the most vocal against the Botswana Government and their treatment of the San, has caused topics of land relocation, indigenous rights, and human rights to become taboo issues in the country. As reported in Lebotse's thesis, Victims or Actors of Development:

> "The lack of coordination between these groups, whether intended or not, [and] the confrontational nature of Survival International's engagement in Botswana has triggered a widespread antagonism against foreign NGO involvements, which stretches beyond government circles….Reverend Braam La Roux of the Kuru family of organizations in Ghanzi, affirming that 'We're afraid of [Survival International]', 'I think there's a general fear among us NGOs and everyone out here about survival… [170]"

These complex economic and resource dynamics were simultaneously caused by a wide variety of social and institutional malignancies. Kiema illustrates in *Tears For My Land* how early anthropologists, whose narratives began the institutionalization of colonialist policies, took data on what their faces looked like, the size of sex organs, observed how they made love, and other unspeakable acts [1].

As they lost their land, the San also lost their ability to hunt. As the community is considered semi-pastoral hunters, they had developed an entire culture, that included their experience tracking and hunting game. However, with the rise of poachers in Botswana, laws were designed to protect all Kalahari game from being hunted. Part of the reason for the 1986 decree was because of the concern that the San were part of the community poaching the wildlife; because the government assessed the hunting methods by the San were no longer the 'pure' methods considered acceptable (through the use of guns), the Kalahari Desert had to be protected against all humans, including all the indigenous [1, 170].

In school, conditions were not much better. The resources do not tell the history and experience of different San communities: "In Tswana history books, the San are portrayed as Stone Age praying mantis worshipers nonexistent in the colonial and postcolonial history of our country, we are primitive nomadic egalitarian hunters." The classrooms are not much better, as described in Kiema's retelling:

> "We were now being taught in Setswana, which we didn't speak, by teachers who couldn't speak [our language]. When we did not answer questions because we did not understand them, the teacher would call us all sorts of names. 'You dogs, tell me the answer, *Masarwana ke lona*, you little Bushman, stop sitting like rotten pumpkins. It's inhuman to keep quiet when asked a question [1]."

The Hitchcock text also outlines the many ways the San are currently marginalized in their experiences. The human rights issues range from:

- poverty,
- lack of secure land and resource rights,
- lack of cultural rights (for example, the right to teach and learn mother tongue San languages),
- lack of civil and political rights (for example, the right to choose their own leaders), and
- lack of intellectual property rights (for example, the right to control and benefit from traditionally important wild plants) [168].

These collective insights speak towards two qualities for those who aim to address the issues of the San. First, the problems are not just historically constructed by a litany of actors and experiences, but they affect the San community in many intersectionally complex ways. On a national level, as the internal dynamics of the San has left the communities without land, resources, and dignity, an extensive collection of communities both local and international have come to step in and address some (but not all) of the issues plaguing this community. The Norwegian Agency for Development Cooperation (NORAD) was the primary foreign donor to the RADP from 1989 to 1996 [100]. However, these complex dynamics speak towards **how international actors, who have been historically involved in interventionism in a wide variety of contexts, are practically limited in how they can help address many of the issues**. Because of the incisive history of Survival International against the government, international interventionists feel that addressing issues of political representation, land acquisition, or indigenous acknowledgement of the San could backfire. With this understanding, we enter the frame of D'kar, the community of focus, where there has been a considerable amount of interventionist experience that has shaped and evolved its experience.

History of Interventionism in D'kar

"There has been a lot of initiatives in D'kar without any results…"

D'kar Citizens

Like many interventionists of all types have done before, I came into D'kar without an understanding of interventionists who had previously walked in my shoes. All I knew is that poverty was a profound issue in the village, which did happen to be the case. As the most recent statistical collection taken from 2009-2010 shows, 59.3% of the population of D'kar lives under the poverty line of 878.87 BWP per year (~ 130 USD in 2010), which is the third highest in the region of Ghanzi and three times the national poverty percentage rate in that year [172]. As I will show, the peculiar context of D'kar even as an exceptionally remote location is a development hub with a wide variety of international connections of communities who intend to interact, understand and engage with the deeply impoverished community.

The solution, however, is not as simple as developing programs that promote self-sufficiency – the people might become dependent on the programs themselves. The history of interventionism must be considered when developing D'kar development interventions. To understand what interventionists should do, it is clear to understand what those have done in the past – both nationally, and locally in D'kar for the Naro. These organizations span a wide variety of focus areas and have had varying success over the years. Moreover, researchers, evaluators, consultants, Batswana and international alike have investigated a wide variety of topics towards many outcomes. After developing relationships with a wide variety of stakeholders who have worked in the community, this section describes a fragmented, yet compelling narrative timeline of the types of interventions that have populated D'kar ever since it became such a unique space. This consistent activity has developed a community where interventionists and projects come and go, but the changes have yet to be broadly beneficial and sustainable.

D’kar and Kuru Development Trust

D’kar is a village in Ghanzi District of Botswana. It is located approximately 40 km to the east of the district capital, Ghanzi. Previous excavations and rock paintings in the area verify that San have been living in the region since at least 6000 years B.C. On April 24, 1898, the first group of Boer Trekkers reached Ghanzi, and another four families arrived that year. They built farmhouses and rode by house for thirty minutes towards each wind direction to stake out their total farmland. A year later, Afrikaner settlers came to take forty farms and a total of 4,250 hectares of land, which immediately disturbed and restricted the natural way of life of the community. Once the settlers placed fences, the farmland didn’t just impact their way of life; it also impacted the natural patterns of the wildlife in the region [171]. The San had no means to defend themselves economically, politically, or technologically against these Boers, The Botswana Government argued that San should settle and give up their old way of life, and as a result, they largely became farm workers and recipients of the relatively meager RADP benefits [171].

Things drastically changed, however, when Dirk Jerkling came to D’kar. Originally farmers in Transvaal, they heard there was a need for a manager in a 3,000-hectare farm in D’kar while they were searching for a similar position in Aranos, Namibia:

> “We found a dry and every place, nothing green. We decided to face the challenge for 3 years and rent out our farm in Transvaal. We saw the people's poverty, we decided to start projects for them [171].”

An Evaluation report on the Kuru Development Trust picks up the history from there:

> “[The members] decided to go buy the farm in D’kar, which was then for sale, and to give it to the church as a mission station. A small school was formed for the hostel, and the farm manager went to Basarwa settlements seeking children to attend the new school. Gradually the numbers grew, and activities for the parents such as leatherworking and sewing were introduced. Funds were always hard to come by, especially after 1982 when the congregation in D’kar became independent from the Namibian church, and ownership of the farm was transferred to the church Council of the new reform congregation. Today membership in the [center] such as leather working and sewing were introduced. Funds were always hard to come by, especially after 1982 when the congregation in D’kar became independent from the Namibian church, and ownership of the farm was transferred to the church Council of the newly formed congregation [171].”

As was established, the area became a rare place where the church council developed secular interventions to help benefit the stark poverty of the community. Originally founded in 1986, The Kuru Development Trust was officially established as a formal legal body once they realized the multi-faceted issues in the community. Kuru, roughly translated as “do it yourself”, stressed the motivation of the organization to support self-help and self-empowerment-based projects and activities. Running as one of the oldest development organizations in the country, the Trust is still working to address the multifaceted issues in the area.

The organization received international resources to support these development projects. For instance, they obtained 967,200 Pula from Danchurchaid in 1994 with funds provided by the Danish International Development agency to assist with the establishment of a training center in D’kar. While doing so, they engaged in an evaluation in conjunction with a water supply project in western Botswana, implemented by the Lutheran World Federation/World Service.

A wide variety of people have come to interact with, develop projects for, and facilitate support on behalf of the KDT. This includes "a Dutch woman wrote a lengthy report on the self-evaluation exercise sheet facilitated at Kuru" in the May of 1989 who apparently came back in 1992 to continue with another evaluation, and two consultants from the Wilgespruit Fellowship Center in South Africa who visited Kuru for a week to consult with representatives from various levels of the Kuru Development Trust [171]. in the October of 1992, and the report in July 1993 that includes this early history and analysis of the development of the Kuru Training Centre. This evaluation activity continued over time; a master's thesis written in 2011 updated the research community on the multifaceted social, economic, and health achievements of KDT, the challenges it currently faces, and suggestions for facilitating beneficial activity moving forward.

Over time, the gaze of focus of the KDT members aimed to serve a larger geographic area; particularly a larger geographic area within Ghanzi District and the Okavango district to the north. Throughout the 1990s, the trust controlled a budget of more than 10 million Pula (US $ 1.57 Million) and employed over 120 staff members. As a result, the organization found it was too fragmented to work under one name and grew to become the Kuru Family of Organizations (KFO), an association of NGOs governed by the San of Botswana and South Africa [173].

At its peak, there were eight collective organizations that sprouted from the first. Alongside the Trust that focused on empowerment-based interventions in D'kar, this included:

- Letloa Trust, "the net", acts as the support organization for the other members of the KFO, and assists and trains in financial management, fundraising, reporting, strategic planning, marketing, while also stimulating advocacy of the San in the Country,
- Bokamoso Trust, who provides quality Early Education to children in rural areas and in other similar circumstances, to provide them a foundation to form of learning in the other transitions in life,
- Gantsi Craft, a non-profit Organization responding to the needs to develop and empower the lives of San communities by promoting, developing and marketing traditional handicrafts of the Ghanzi and the Kalahari District abroad,
- Komku Trust, an organization that supports the development of an enabling environment that creates strong, equitable, healthy, stable, and empowered communities in seven settlements of Ghanzi in the topics of Land and Livelihoods, Health, and Primary Education,
- The Trust for Okavango Cultural and Development Initiatives (TOCaDI), who serves the San populations around northwestern Botswana primarily in working towards their land security,
- San Arts and Crafts, a community-oriented enterprise based in Ghanzi to profitably and sustainably market traditionally inspired Kalahari San products, and
- South African San Institute, who strives for revival and implementation of the cultural identity and heritage of the San in Southern Africa and promotes their socio-economic development [174].

Over the years, the organization has worked to develop a profoundly positive impact on the D'kar community. As it evolved, however, multiple unexpected challenges arise with which the organizations and citizens must grapple. By becoming arguably too successful, KDT had lost funding from donor agencies, as the funding sources believed the Trust could be run using the

funds from the wide variety of projects. During the forming of KFO, there were also issues related to perceptions of corruption and improper use of power, as certain D'kar community members accused KFO officials of receiving benefits in the form of status, salaries, and Trust vehicles to run personal errands. The organization is also dealing with the challenge of the lack of San representatives with the capacity to run the Trust [173].

To support the needs of the community to engage in San activities, KDT and the Dutch Development organization also helped the San of D'kar buy 6336 hectares of freehold land at the QaeQare Game Farm in 1994. While also progressively getting farmland back to the original residents of the land, the purpose of the purchase was also to address the issue of overexploitation of D'kar farm area by livestock through emergency grazing [175].

Both KDT and the KFO runs to this day. Early in the organization's history, the activities were described by development practitioners at the time: "[The] story of Kuru is one of dynamic energy in fluidity." These organizations work day-to-day to accomplish the goals of the community they serve [176]. Today, they continue to set the vision of empowerment for and by the San, through the development of a horticulture project, leather products and paper-bead making projects. They also provide some health care services, promote San culture and crafts, caretaker services, and a wide variety of ancillary services to the D'kar community [174].

Naro Language Project

Another well-known development project in the area is the Naro Language Project. The Khoesan community (an umbrella cultural signifier representing the Khoe and the San people) are linguistically unique in how they use click consonants in their speech. The primary language spoken in D'kar is Naro, which has twenty-seven individual click consonant letters. Naro is one of 12 Khoesan languages in Southern Africa and San in the east of Namibia speak it as well. About 15,000 people speak the language: some 10,000 speak it as a first language, and more than 5,000 people use it as a second language [177].

The languages are primarily oral in nature. As a result, there did not exist the capacity nor a cultural reason for San to learn how to read. Therefore, the Naro Language project was founded to develop an understanding of the Naro language, to increase literacy by teaching Naro speakers to read, and write, and to translate the Bible into Naro to support the development of this community. When Reverend Willemein Le Roux came to the community in 1982, they developed a preliminary orthography, so the church could communicate the Bible in Naro. In 1991 Drs. Hessel and Coby Visser arrived, and needed to more systematically research how to make the language practical and culturally respectful. They conducted research, invited a gathering of local and international language professionals to develop a better understanding of the dynamics in developing this orthography, and eventually published a Naro-English Dictionary in 2001 [178].

The office published the New Testament in 2012, and to this date, the Old Testament is fully drafted and more than 99% fully translated since the last visit in February 2018. The activity employs a collection of San, working to translate, sell, and manage the organization. As the full Bible is almost complete, Drs. Hessel and Coby Visser have turned to work with other indigenous language programs in Southern Africa to consult on their linguistic and orthographical needs.

Working Group of Indigenous Minorities in Southern Africa

Another long-term organization in the area, the Working Group of Indigenous Minorities in Southern Africa (WIMSA), strives to develop the political voice of San in the country. It was founded in 1992, as explained in its history:

> "At the regional Conference on Development Programmes for Africa's San population held in Windhoek, Namibia, in 1992, the San representatives resolved that 'San peoples should be assisted to form committees to represent themselves at local, regional and international levels'. This need was reiterated during a follow-up conference held in Gaborone, Botswana, in 1993, where the San delegates called on national governments 'to support the formation of Basarwa national fora... [179]"

WIMSA eventually established a Botswana chapter in 1996 following repeated requests from the San in Botswana and Namibia at 1992 and 1993 conferences. They collectively agreed that WIMSA would facilitate supporting and networking with the San in South Africa, Angola, and Namibia, and that WIMSA Botswana would address San affairs in Botswana, Zambia and Zimbabwe. D'kar hosted fifty-four San delegates from South Africa, Botswana, and Namibia at the Conference on Self-Development and Resettlement by WIMSA in 1995 [179].

The WIMSA Botswana community works to 'develop the political voice' of the San in Botswana and tries to make this known in the rest of the country on a wide variety of issues. Alongside a wide variety of groups, including the First People of the Kalahari, the aforementioned Kuru Family of Organizations, Dishtwanelo, the Botswana Centre for Human Rights, and many others, the community had worked to address issues related to education and training, heritage and culture, institutional capacity building, issues related to HIV/AIDS, San human rights, land and natural resources, international cooperation, and networking [180]. The representatives also act as grassroots advocates and thought leaders for San experience and human rights: Mathambo Ngakaeaja, a facilitator and main organizer for IDDS 2016, was representing WIMSA by presenting a paper on development and human rights by reflecting on the lessons and principles of the Kuru Development Trust's experiences up to 1998. In the 2003-2004 Report, Mathambo is the WIMSA Botswana Coordinator in Windhoek, and it mentions the present dynamics plaguing the San at the Central Game Reserve and represented the organization at workshop committees by the Indigenous Peoples of Africa Co-ordinating Committee in November 2003 [181].

D'kar Art and Culture Activities

Another critical development solution directly tied to the concepts of cultural advertisement and empowerment are the many different art and cultural practices portrayed by the San. As was expressed before, a wide variety of institutions in Botswana and the rest of Southern Africa do much work around selling the 'San cultural experience." San art is appreciated worldwide: artists have won awards at the Artists of Botswana competitions, the Graphica Creativa Printmaking award in 1993, and design murals for the main government hospital in Gaborone, Botswana. Moreover, the Kuru Cultural Centre (established in 1992) focuses on performing arts and cultural heritage of the people of the Kalahari, and it houses a museum, permanent art collection, library, and information center [182]. Both spaces offer opportunities for San Art to be appreciated, taught, and sold to visitors from all over the world.

Another famous cultural activity is the Kuru Dance Festival, which is held in August every year at D'kar in Botswana, hosting many different dance teams from all over southern Africa in for a few days of exuberant performance. Far from its private and spiritual origins, it has become a vibrant modern celebration of the distinctions and similarities between the cultures of different San communities, and a manifestation of San-ness in the contemporary world [183].

However, there are a wide variety of concerns researchers have voiced over these types of interventions, particularly the growing tensions between becoming economically sustainable and the false representation of San cultures. Gaebuse particularly illustrates how a crucial part of San culture, known as *Cii* or trance dances, are warped for the needs of outsiders:

> "The Naro also do their performances as a form of entertainment for tourists and before political dignitaries during special event... Groups have contributed to the loss of value of the trance dance. The influx of tourists, the Naro are asked to perform and in return they get some money. The ceremony is no longer performed as a means of alleviating stress, settling disputes or giving thanks to ancestors for the wonderful job the Naro have achieved. The same happens during Independence celebrations or some other occasions when there as to entertain the guests.
> Because of the money economy, Christianity and modern laws, trance healing has lost its originality as a ritual.... Commercialization of performance has contributed to the loss of the Sacred nature of the trance dance. Traditionally the gifts of the Spirit were originally free in an African society. This was because who had the powers to perform miracles did that with the instruction and guidance of the spirits. Therefore, the issue of money has cut that strong bond that used to exist between the people and their spirits [184]."

Desai also mentions how the selling of ancient rock art and traditional folklore require these communities to perform primitiveness for visitors, instead of representing their cultures in true, evolving ways:

> "While traditional crafts and Contemporary Art might have been utilized as economic deliverances, from this property they have instead let the further exploitation…. 'Did they want me to join their society or continue my disrupted old way of life? *Neither*, they want you to leave the animals alone, yes still pretend you live among them and then create art based on that act.' The once utilitarian uses of various items, such as ostrich eggshells, hunting sets, and skins, have been reduced to mere marketing items used only in an exchange for money. If an item is not selling, the artist is told, and it vanishes quickly. If tourists seem to buy a particular material more often than others, that material, never used before in certain items, may be incorporated into everything (regardless of traditions or durability). If artist chooses to experiment with modern materials, they are told that their crafts are of bad quality. Contradiction arises while separating Bushmen from their land, wildlife, and lifestyle yet still asking them to adhere to materials found there to make items used only there. All this based wholly on the Western tourists' dollar. [184]"

Lifelong Learning and Entrepreneurship: Ba Isago in D'kar

In Raditloaneng and Chawawa's *Lifelong Learning for Poverty Eradication* documents yet another empowerment-focused intervention program focused in D'kar is discussed. From 2009 to 2012, as a part of a collaboration between Ba Isago University and the Kellogg Foundation, they developed an adult education training program focused towards entrepreneurship. The training session objectives were meant to share personal experiences, to encourage participants to consider self-employment as a potential career route, and to isolate critical 'non-technical' skills of business management. The authors frame the case study in the context of describing, analyzing, and

advocating for "context sensitive approaches to lifelong learning can connect individuals and groups and stimulate their interest in learning to learn." The organization concluded that many of the institutions that exist to benefit the local Motswana, such as LEA and CEDA mentioned above, were institutionally and geographically inaccessible to the San in D'kar and resolved to develop a program for them to access entrepreneurship resources and mentorship. Moreover, existing programs focusing on alleviating poverty in the communities like D'kar, such as food basket programs and "Brick-and-mortar" solutions like schools and hospitals "do not solve social exclusion, low self-esteem and discrimination."

Therefore, the collaborative the program developed and taught the Zooming Approach to Entrepreneurship, specifically to provide business skills to eradicate poverty among the San people. The program also provided the "nuts and bolts of running a business and looks into the challenges of operationalizing business knowledge and theories." Participants were introduced to the various steps of the Logical Framework Approach, by including methods of stakeholder analysis, problem analysis, objective analysis, strategy analysis, project plan matrix, activity planning, budgeting, and monitoring and evaluation [168]. Though there was considerable interest in continuing the workshops and much-reported learning in the workshop, the program could not last past donor funding.

The current executives of the Kuru Development Trust feel this pressure as well. One respondent discussed with me how empowerment activities require considering how the communities get supported once they've reached past the initial stage of empowerment.

> "[For instance,] now that we've trained people to make shoes, we need a place to make shoes. The community depending too much on government or depending too much on donor organizations. We have to take it as a challenge, take mentality… you have to potential to do things for yourself. You must know all your stakeholders, what they are bringing, or, what is Kuru going to do in this relationship. Is this project going to be sustainable? Will be able to use it in your absence? That person who is empowered, is he empowered?"
>
> Executive, Kuru Development Trust

While we talked, I asked this question of myself as well. When does empowerment become dependency? When are they one and the same? There is, however, another way to frame the complex and dynamic oppressions the San community have experienced: through the ways in which they are empowered to become actors in their own development. Lebotse, in "Victims or Actors of Development: the case of the San People at D'kar, Botswana", speaks about how the development project intends to increase empowerment and self-sufficiency, but instead creates a relationship where the San become dependent on the programs, which limits the opportunities for San to act towards their own liberation.

> "…the San people want development in their regions as any other citizen but because there has been throttling advocacy to preserve their culture the results has been that culture and its aspect of primordial stance has stood to benefit them even more [170]."

> "... such an approach could render the San increasingly dependent on powerful donors and create obstacles for San communities seeking to develop independent and effective local community and leadership structures, as given the limited financial resources available, NGOs are becoming more dependent on the whims and fancies of international donors, state aid agencies and corporate patrons. In other word[s] **ethnic separatist strategy** that was perceived to be strategic during the San land claim process, and which was supported by NGOs and donors, **could contribute towards erecting an artificial barrier between communities** even though many of the San claimants come from these neighboring areas and have close kinship ties with people living there. This realization therefore highlights the symbiotic relationship between the San people and the project they are involved in [170]."

The platform set initially by the Dutch Reformed Church and the resources that have funneled into the organization represents a deep interest in addressing rural poverty, and D'kar is a unique catalyst for the activity. Anyone who has spent time in D'kar has learned about the complex dynamics in the village, where the most prevalent outcomes are tensions related to differential positive outcomes of these many interventions: many people saw others benefit from the projects and did not benefit themselves. Indeed, it is unlikely that any outsider to the community can fully understand the historical tensions that exist in this sacred land.

At the same time, interventionists have still been attracted to come here; to buy from the Kuru Art Centre, to learn about the deep history of the San community, or to potentially develop another revolutionary plan to address the deep poverty. Implicitly, these issues are rehashed, reframed, and re-intervened upon, each time a new community comes to learn about D'kar. The visitors and expatriates yearn to help, though they leave having made relatively little discernible impact on the community. What is interesting about the different interventionists is, though they come aiming to investigate the same problem, and they have similar theories for how development must be related to the empowerment of the San, the areas of study are widely different: from teaching entrepreneurship, to selling Kuru art and culture, to building training centers, to teaching the San to read. This quality speaks to the range of expertise of the interventionists, and how they leverage those activities to assist the San. Moreover, the national context as explained in the previous section leaves interventionists from contributing to the issues through political means, leaving out entire dimensions of development. The disappointing fact that little has changed in the eyes of some D'kar citizens speaks to the complexity and intractability of the existing problems.

In no way, however, are these insights meant to decry the years of work from a variety of different entrepreneurs, who have in their own ways toiled to make the plight of the San relatively better. All activities aimed to relatively better the quality of society are worth moral praise, to some extent. This narrative speaks instead to the *negotiation that development actors must make to be able to address the intersectional dynamics of this community completely*. I instead critique the system and history that limits more substantial and sustainable change.

A wide variety of institutions – banking, health, food, housing, and otherwise – are at least a thirty minutes' drive from the main housing site, and this fact contributes to the stream of interest to ensure this community can become more self-sufficient and empowered. If the reader can forgive development colloquialisms, the community is plagued with an evolved example of the 'last mile' problem. **D'kar might be proclaimed a development oasis,** leads to at least two outcomes. Firstly, the community has access to resources that rarely exist in other locations in Botswana, which might directly or indirectly lead to further resources being localized there in the future. This then leads to unintended outcomes, like development fatigue and increased tensions as the villagers

fight over the meager benefits that can even make it to D'kar in the first place. Secondly, while the interventionists focus on the 'oasis's' rightly prominent and pressing issues, the interventionists rarely develop the opportunity or the resources to broaden the gaze towards other locations, towards other levers of interventionism that could address social malignancies, and towards other forms of sustainable impact.

These few organizations likely only represent a shadow of the many organizations, communities, and initiatives that have populated D'kar sand, each with its own visions, incentives, resources, and capacities. In this, it would be useful to D'kar citizens and future interventionists alike to develop an evolving, participatory timeline of the activities in D'kar. Learning about who they are, what they offered, who benefited and how, can facilitate discussions about how new solutions can bring different interventions to D'kar. What these interventions do develop, however, is a clearer context for the immense amount of development activity that IDIN 2016 finds itself. Conversely, it also gives me the opportunity to identify what qualities and outcomes are like historical interventions, and what is unique to IDIN as an intervention.

IDIN's 2016 International Development Design Summit

Figure 16: On top of the sleeping quarters in D'kar, IDDS Botswana 2016.

On June 25, 2016, I arrived in D'kar with the rest of the participants to start the four intense weeks of co-design practice, with almost no understanding of the context or history. Much preparation occurred on the side of the facilitators to ensure the activities would be a success. In fact, planning started as soon as the they completed the 2015 IDDS; Mashaba, the lead organizer, had been collaborating with the University of Botswana to develop the methodology and logistical plan to move forward, and as early as November, the stakeholder committee were in motions to improve the business plan, fund, and build the entire innovation center for the next workshop [162]. Over time, the community members collaborated on choosing potential projects that the IDDS organizers would shortlist. The project was advertised nationwide, on the radio and in university newsletters [185]. Though I had primed myself on the design and evaluation approaches of IDIN, there was still much to learn about the vision, activities, culture, and outcomes of the innovation community. The section below outlines the diverse, pedagogically supportive, poverty-sensitive, creative, and strategically impactful culture of an IDDS innovation summit.

Being Introduced to IDDS Culture

The facilitation team made it clear the pedigree IDIN had built over its short life. During the early presentations, they mentioned a wide variety of personal stories all about local entrepreneurs who were exposed to the CCB methodology, the tools created from previous IDDS's, and the many success stories. Examples include a single entrepreneur who, after going through the IDDS experience, has reportedly developed over 100 new inventions using the design method. The story talks about how the IDDS community has gone through many different iterations of what it wants to accomplish and learns from each experience along the way. The community started as a conference that focused on developing meaningful solutions for people in poverty. In doing so, it has evolved to include a litany of other interests, activities, and capacities over its decade of operation.

- In 2007, IDDS focused on developing prototypes instead of papers,
- In 2008, it focused on developing the technologists along with the technologies by ensuring the method focused on creative capacity building,
- In 2009, it ensured the IDDS members would work with the real users of the technologies,
- In 2010, it focused on developing business models for the existing technologies, so that prototypes could evolve into products and products could evolve into ventures,
- In 2012, they developed an IDDS where the entire organizing team was local to the community context, which allowed more than one summit at a time,
- In 2013, they aimed to build networks between people to facilitate better collaboration while they innovate,
- In 2014, they worked on resources that facilitated project continuity after the summit,
- In 2015, there was a focus on scaling the technologies to be developed during IDDS [186].

This process isolated the multifaceted principles that IDIN used to design around, and thus the principles they bring to IDDS: how the summit is hands-on from the very first day, how they focus on doing and making instead of listening and lecturing, how it builds the capacity of people, not just products, how it develops space for co-creation between a diversity of stakeholders, that the products produced must be holistically designed, such as considering how they are bought, sold, and repaired, how a community must be built around a particular summit, how building connections between IDDS participants all over the world is critical, and that the technologies must have the potential to scale.

There was a wide collection of facilitator roles to be filled during the workshop, including but not limited to:

- Lead Organizer, the overall manager and head visionary of the summit,
- Lead Instructor, the head of all teaching and lecturing activities,
- Design Facilitators, the heads of each individual design team,
- Communications, the facilitator to ensure all information about the summit is communicated between participants, and after the summit, is accurate and disseminated effectively,
- Participant Experience Coordinator, who ensures the participants receive the best experience possible,
- Workshops, ensuring the activities of the workshop are organized and run efficiently,
- Housing + Food, who ensures the room and board issues are managed efficiently and accurately,
- Transportation, who facilitates movement of the summit participants from place to place,
- Events, who organizes ancillary events like cultural development, student presentations, and movie nights,
- Health + Safety, who prepares for and makes sure everyone's wellbeing is taken care of during the entire summit,
- Monitoring and Evaluation, who determines evaluation purposes, approaches, and gathers data on the experience, and
- Community Organizers, who facilitate relationships with the D'kar community.

It was clear from the beginning that the summit worked to inculcate a culture of tangible and locally accessible making unlike any other. From the first day we were immersed in kinesthetic design practice. As soon as we got there, we were immediately assigned an 'angled ball problem' on the first day, where we charged with slowing down a random ball for a random amount of time on a plywood 2x4 angled at approximately thirty degrees using a litany of tools: string, sand, paper, glass, and much more. Such a lesson gets designers involved in learning by making, in collaborating with a team, aiming to address difficult solutions, and dealing with deadlines. During the workshop, we developed opportunities to test and learn specific making technologies: we learned from D'kar villagers how to make arrowheads and traditional games from feathers, cow tendrils, and sticks, and we also were split up into teams where we learned useful innovation-centered skills, such as cutting glass bottles, arc welding, and battery-powered foam cutters, which could likely be used for the development of sketch models and prototype technologies.

Figure 17: Traditional San feather-and-bead game-making.

Figure 18: Traditional San arrowhead carving.

Figure 19: Sketch modeling workshop making foam cutters.

There were also multiple opportunities for the international participants to share their culture with the rest of the community. The Morning Circle, a tradition at all IDDS workshops where all participants gather at the beginning of the day, was done around the *molelo,* roughly translated as to "to warm yourself with fire." Each day, a participant leads the circle and shares with the rest of the community an aspect of their culture; as a previous drumline section leader, I introduced the IDDS family to show-band marching technique and call-and-response of band activities. It is also where the IDDS community notes what they appreciated about the previous day's events, what they hope and dream for in the future, what problems and solutions they bring to the space, and what announcements they have for the day. Around the circle at night, participants get a chance to engage in a wide variety of activities: to wind down, to learn more about each other, and to poorly sing Brazilian folk songs at 10:00 at night at the top of their lungs. We also learned a bit about the sensitive nature of the activities we're engaging in around the *molelo;* how many projects have occurred in this unique location, how there has been differential benefit across the village population, and how bitterness has evolved from these many different projects. During the final Morning Circle, as we were leaving, we took time to reflect on the impact we have had on the space, and the space had on us, and look towards the future as new members of this growing community of IDIN network members.

There were also nightly participant presentations, where each person gets an opportunity to present about their life outside of IDDS. As I wanted to ensure people knew about my own research motives, I took the chance to present my research goals and activities that I wanted to utilize during the workshop, and the potential outcomes of my research. Also included in the schedule is a talent show, a San Cultural Night, an international snack fest, a potluck, and a final graduation at QaeQare Game Farm.

As we progressed through the experience, we gained multiple lessons on the importance, applicability, and dynamicism of design practice. An important goal of the workshop was to ensure that everything and everyone was developing during this design project; particularly,

- **The products:** the design teams would work to determine useful, culturally appropriate, technologies that would benefit our user communities,
- **The projects**: the design teams would strategically develop plans to determine business plans, apply resources, and develop continuity plans to ensure the projects sustain, deepen, and spread their impact,
- **The people**: The people involved are positively changed by their experience, from increasing their creative confidence, from learning skills, from forming visions for potential future projects, by developing connections between the rest of the community members, and
- **The process**: that everyone there develops a deep respect for the co-design practice, spread to each community member and available for an extensive collection of local and global problems.

What the facilitators also taught was the importance of facilitating spaces for creative capacity building. The IDDS representatives differentiated between other philosophies of innovation practice, including Human-Centered Design, where designers distanced from the end users create the technology by better considering their personal experience, and simple co-design, where communities collaborate and facilitate, but might not mutually build up design skills, resources, connections, or other capacities in the process. In this, IDIN mentioned how facilitating empowerment drives most of its actions: to build those capacities for communities to design their own solutions and address their problems themselves. Notable metaphors used were Maslow's hierarchy of needs, where design practice and development are directly aligned with a person's self-esteem and ability to self-actualize themselves, emphasizing that everyone deserves to have that experience, regardless of impoverishment. There was an illustrated difference between simply giving someone new technology, teaching someone how to use the tech, and teaching someone how to create new technology, implying the final activity gives everyone the opportunity for context-specific self-actualization. Also related is how the IDDS facilitators described the difference between different styles of co-design: 'Design For', 'Design With', and 'Design By', as was outlined in the previous sections of this dissertation. In this, what matters is ensuring the designers have the wisdom to know when to use which methods It was also critical that the activities at the workshop were not just beneficial to the participants, but that they were useful to the end users and communities as well. To ensure this relationship receives the final blessings of the community, we visited D'kar's Kgotla at the beginning of the workshop. It also facilitated space to invite the community to interact with, observe, and potentially design the technologies, depending on the needs and abilities of the individual design groups. Amy Smith presented the six team names and the projects they aimed to address:

- HÙIKU – the Deep Sand Wheelchair, and my project,
- CGUI – a Morama Nut Sheller,
- X'GAE – Interlocking Building Blocks,
- CÁM QGAM – a Solar Glass Bead Furnace,
- C'EEKGAM – a Sustainable Tea Maker,
- EZ NCORO – a Human-powered Washing Machine.

The CEOs of BITRI and BIH, who helped sponsor the workshop through funding, donating resources and time, and by offering participants as a part of the IDDS community, were present to help kick off the month of design activity. Because there was an IDDS workshop last year, the community had mentioned how their perception of the IDDS had changed over the year:

> "I now realize that I had a serious misunderstanding about IDDS. Because I thought that IDDS was brought here to belong exclusively to the participants. Now I am learning and understanding that this is actually a community project. The center is established to benefit the community. And so, I invite all of the community members to use the center...to help people solve problems."
>
> Kgotla Community Representative

Figure 20: IDDS Kgotla.

In aiming to address these problems, it was clear that the organization didn't just facilitate innovation; they worked to be organizationally innovative as well. The organizers sought to ensure the participants would bring the most significant value to the four-week summit. In fact, a few weeks before the summit they were open to including at least two new participants they had not previously included. The CCB facilitators who ran the Seronga summit noticed one student who performed so admirably with the chili crusher team that facilitators invited him to the larger IDDS held a couple of days later. This also happened when an IDDS organizer went to dump supplies, and a genius mechanic who helped to repair his car was then invited for the four-week event.

There was also essential space made for getting to know and bonding with the teams we would be with for the next four weeks. First, all the participants were carefully placed into groups based on a wide variety of factors: diversity of expertise, diversity of location, personal interest in the project category, language translation skills for the non-native English speakers, and other reasons. My group, Hùiku, was the largest group; we had members from D'kar, from Botswana, who spoke Naro, Setswana, English, Vietnamese, and many other languages. Though this wasn't made clear until later, the wheelchair project was the most precarious of the six chosen, as the participants would be directly interacting with a marginalized community inside a marginalized community: the differently abled, people with paraplegia, and the immobile San villagers. Thus, the IDDS community made sure to have three wheelchair specialists to ensure the work was even possible and ethically pursued.

There were team-building exercises, such as:

- Everyone presenting to the team the meaning behind their name,
- The team finding three things that everyone in the team shares, and three things that are different,
- Building a huge human knot, and working to un-tie it completely, and
- Team work-style questions, such as "Do you work well alone or together?" and "Do you like to work on technologies, or on things after the tech?" to determine the style and interests of team members.

There were also a wide variety of related learning opportunities the facilitators considered necessary because they offered useful insights to the participants, although the activities weren't directly tied to the projects. For instance, the Design for [X] Workshops were a collection of short lectures that gave the participants a crash course in understanding alternative, yet complementary design philosophies. By speaking about why the category is important, the design facilitators teach participants about when the design philosophies should be considered, some focus areas about good and poor design in the field, and where they can learn more about the topic. In this IDDS, the design facilitators covered design for repair, design for ergonomics, design for sustainability, design for affordability, and design for failure as topics. It also gave the participants more fuel to determine if their D'kar designs ascribed to 'good' design principles, by considering the supply chain of resources, the abilities of local users to fix the tools, if the technology fits the human body appropriately, and many other questions.

The IDDS facilitators also developed space to develop a gamified scenario where participants had to make business decisions, so they would recognize the experience when the time came to turn projects into business ventures. Called the Market Activity, the participants were placed in a random team, planned the development of a product, bought materials for and made the products

(with fake currency), and sold those products to the rest of the IDDS population for one full day. The experience gave the participants the opportunity to learn about the tensions between making certain buying selling decisions and determining what products would deliver value to the rest of the IDDS community. For instance, my team decided to make miniature *molelos* that participants could take home to help commemorate the experience, and another team developed IDDS Botswana picture frames that would be included in every picture to decorate their Market Activity experience.

The community also offered the opportunity for participants to teach what they know to other participants. By holding time for peer-led skill workshops called 'How-To sessions,' a participant had the opportunity to teach some skill or to develop a tool where there wouldn't have been the opportunity otherwise. This experience aims to leverage the immense and diverse expertise that arrives at an IDDS summit to build the social capacity of the entire community. Examples of peer-led skill activities held at the D'kar summit include a topic as big as starting local innovation centers, or as small as making their own corn shellers.

IDDS facilitators also offered the opportunity for participants to develop their own workshops on topics deemed essential to communicate. Leveraging this opportunity, I was a part of a team that put on a seminar around the *molelo* about the importance of good storytelling. As design practice runs on the ability to communicate the world as it is and the world as the designers want it to be, we wanted to make sure we held space for talking about what makes good and bad stories, and space where participants could practice their storytelling skills.

Designing Desert Mobility Solutions

As my team initially got to know each other, we also developed the aforementioned team name for our project, Hùiku, which is roughly San for 'helping each other,' and a team charter that outlined: the vision, the team members, and team facilitator, the shared vision of success, the collective principles of team collaboration, the ground rules for different team meetings, the roles and responsibilities for the participants (though they would evolve and change over time), the decision making processes, and the mechanism we would use for conflict resolution. Because of my personal experience with design projects like the IDDS style, I requested to be the meeting facilitator, and the manager of media, including photographs, videos, and recordings.

As a team, we worked through just over three weeks of a design process, relatively outlined by the IDDS Design Workbook [187]. Though it was stressed that the design methods don't have to be completed in the order of the book, we developed the prototype in roughly the same order as the text; by first framing the problem, creating a solution, and by producing a product. Although an in-depth explanation of all methods is available in the textbook, included is a short explanation of the process we engaged in to develop the wheelchair.

To ensure we sufficiently understood the problem, we first aimed to understand the stakeholders we should approach to ensure we adequately understood the San context. By using methods of stakeholder analysis, we listed important actors in the village, why they might be interested in the project, the effect these interests might have on the project, the importance of the stakeholder on the success of the project, and the degree of influence of this person over other stakeholders. We developed a list of people who are handicapped, our end users, the family of the handicapped, the neighbors of the handicapped, our design team, those who buy wheelchairs, those who

manufacture wheelchairs, others on the wheelchair supply chain who would get them to D'kar, the builder of buildings that make them wheelchair-inaccessible, the chief of villages, the innovation center, the Church Council, the Kuru Development Trust, the Botswana Innovation Hub, the Botswana Bureau of Standards, Wheelbarrow Salesman (who currently sell wheelbarrows to people who take the end users around), primary schools, hospitals, and Botswana disability organizations, and any service clinicians in the country and abroad. We kept in mind which stakeholders could eventually turn into future collaborators for the project.

We then developed a list of all the different stakeholders we wanted to learn from in our short time and made a research plan to interact with them. During the early days, we received a crash course in gathering user information; ensuring that we were respectful, that we had our eyes, ears, and hands open to ensure we engage with the users in all ways possible, that we took as much data as possible, and we had the opportunity to talk about the insights from the community right after we completed the information gathering process. As a researcher myself, I suggested to distill the questions we ask the community into six categories:

- Tell us what a day in your life is like.
- Where do you want to go?
- What are your challenges?
- How do you live/work?
- What do you want to do?
- Who helps you, and how?
- Who else should we talk to about this problem?

However, if need be, we made sure to open up the opportunity to ask about topics that would seem relevant if they come up in conversation. We collected data by asking the community members, observing them live their lives in their spaces, sometimes working with their materials. We also ensured that different team members would have their eyes open for different categories of data: one member focused on the technical issues and capacities of the mobility devices with people, another focused on how the mobility devices might impact the health of people, another focused on the physical spaces the differently abled people find themselves, and others. Each new insight led to a whole new collection of questions about how these communities lived their lives; for instance, how they transfer to the bathroom, or if the tools in the yard were used to fix the wheelchair in any way.

After synthesizing the information after each of the six interviews and at the end of the days through sharing stories about what we experienced and what was useful, we then categorized the potential end users into three personas: those who cannot leave their bed; an old, fragile person who cannot go far; and someone who is relatively capable, yet injured in some form. It was then time to decide: the end user that we decide to focus on for the rest of our time at the workshop would define the technology we decide to create. For example, focusing on those who are bedridden means whatever solutions we develop would make their lives demonstrably better with even meager solutions, but would likely never become relatively mobile. The most mobile end users, however, might be able to move around and become more independent through our product. However, this community's qualities and aspirations might be so diverse that our team might have difficulty isolating which needs to address.

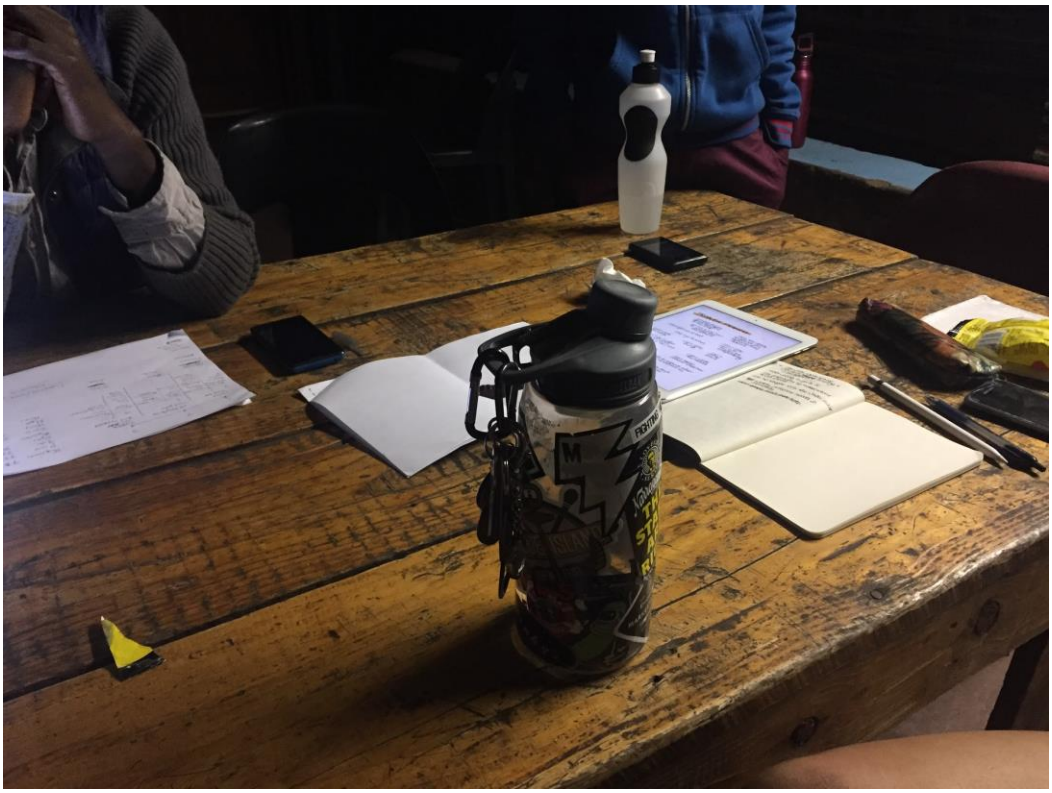


Figure 21: Hùiku team deliberation.

Eventually, we decided to focus this time on the capable, yet injured users. The reasons were as follows:

- The project was intended to focus upon the idea of mobility. For much of the other communities, it would be difficult to develop an intervention, with our tools and the tools of community members once we leave, that would drastically increase the ability for those who are dependent on others to leave the bed. Also, if we were to assist with community members that are not profoundly injured, that would require the development of an eventual intervention that would require a reconsideration of the entire system of health care in D'kar and its obstacles: from the family around the people, to the health center, to maybe other transport communities. Unfortunately, we did not have the time nor the space to investigate those system actors; nor were we given the methods to consider the issues from that type of system perspective.
- Secondly, scaling is an important consideration in these spaces. If we could develop an intervention that addressed the complicated and informal system of healthcare in the area, we were unsure how easily that technology could then be scaled.
- Thirdly, we considered the expertise of the design facilitators, and of the team. Much of their work has been on addressing mobility through wheelchairs. Did we have the capacity to develop a useful intervention with the short time we had at the workshop that wasn't wheelchair-based?
- Lastly, we wanted empowerment to be a cardinal principle we incentivize through our technology. By building a technology that can make the end user independent, they can then help other people as well.

Over time, we eventually developed our problem framing statement: to focus on decreasing the effort of independent mobility of wheelchair users outside and around their house, and to adjacent houses around them – about 10 to 100 meters of movement.

After blue-sky brainstorming activities, we developed some solutions that might make sense to try in person; developing tank treads, making smaller and larger wheels, car wheels to increase the flotation of the wheelchair, and many others. We then developed sketch models, or early stage three dimensional prototypes of our projects out of wood, bicycle parts, metal, string, and other accessible materials in the Innovation Center, which could be used to gather data at the first community presentation through interacting with the villagers.

After extensive data collection, detail design, utilizing multiple evaluation methods and developing a plan for a final proof-of-concept prototype, we then developed a prototype wheelchair accessory kit. After researching the market competition, and learning about development-centric, off-road, and electric wheelchair markets, we realized we found a niche in developing tools that could modify the many standard hospital wheelchairs in off-road environments worldwide. As explained in our Final Report:

> "These parts include rear wheel, front wheel, and lever mechanism modifications. The wheel modification seeks to increase flotation, or decrease pressure of the wheels on the sand it rolls over. The user's existing rear wheels will be replaced with a double-rimmed rear wheels assembly. This increases the width of the tire, therefore increasing the contact patch and reducing the load per area of the tyre of the user moving on deep sand. The front wheels are moved further out from the original caster wheels and angle the chair such that the original casters are above the rolling surface by 5 cm to keep them from dragging. Because the front caster has a longer lever arm from the center of gravity of the rest of the chair, it exerts less force on the sand than the original casters, and thus rolls easier than the original wheels [188]."

An extensive outline of the rest of the activities and decision made during and after the workshop are available in the Final Report.

Figure 22: Final wheelchair prototype [188].

Figure 23: Double-rimmed wheels [188].

Figure 24: Front caster wheel [188].

During the final presentation in the third week of IDDS, we began to glean the potential impact of this hectic summit. During the final presentations, a wide variety of stakeholders were present to see the final technologies the teams had developed. Many of the representatives from the original Kgotla were present from BIH and BITRI, as well as many villagers from D'kar, but also represented was the USAID Botswana representative, Bakang Chigani. The member gave a speech about the organization is proud to support the Kuru Development Trust, BIH, and IDDS as well, and how programs like these align with USAID's mandate of global development labs which aim to end extreme poverty by 2030. By supporting the development and creativity of the San community, IDDS is an opportunity for the country to use indigenous knowledge and products, which contributes to the hope that one day they will contribute to the national economy.

In this, each of the teams presents their projects through summative PATH statements. The acronym stands for Purpose, Approach, Technology, and Heart, intended to show the problem they solved while at IDDS and how. We then presented our prototypes to the collective at the presentation that they could then interact with for hours, and we had a celebratory braai with the village.

Setting a path for the future

After the final presentation, the last activities we had left to do were to gather the media we had collected for the workshop, finish our team report, amalgamate the photos we collected over the four weeks, and develop a video of our experience in D'kar. We aligned the structure of the video with the PATH statement: we talked about the problem we aimed to solve while in D'kar, we talked about how we approached addressing the issue, we talked about the solution we prototyped, and the hopes we have for the technology. These resources would be used by the IDIN office communication materials for a wide variety of uses: advertising, marketing, and building knowledge of existing technologies, among others.

We also had to develop a continuity plan for moving forward. To support these decisions, we were given resources to facilitate conversations about value, ownership, and collaboration of the project moving forward. The IDDS office offered questions that required all teams to debate seriously about the continuity of the project:

- What are the different ways your project is creating value? Who receives the value, and if necessary, should the project continue?
- If the project should continue:
    - How? What are the technical concerns, what user testing is necessary, and what needs to happen in the next few days to sustain it?
    - Where should it continue? Can it continue in D'kar, or does it make more sense to continue in another location?
    - Who can, and should, continue it? Who wants to continue working on the project, and how much time can be spent on making it work, and what are other people's roles?
- What resources are needed to continue the project? This includes considering where you can obtain tools to work on the project, materials to adapt to the technology, funding to sustain the project, skills and knowledge to continue the project, and mentoring or technical assistance to direct the work?
- Finally, in what ways can IDIN help with the process?

Previously in the summit, presentations were made on the many resources IDIN has developed, as stated earlier in the dissertation, and in what ways those resources are available to budding entrepreneurs. The facilitators made it clear how important it is that these projects don't just sit in an office, but they become projects that benefit people in D'kar or abroad. The team had various levels of interests, and capacities they could eventually bring to the project. With that said, there were two main categories of continuity decisions we made on the project.

First, we decided it was too difficult to make a case for developing a sound plan for continuing the wheelchair project only in D'kar, for a few reasons. We were influenced by the complicated history of development interventions and felt concerned by the ethical implication of only a few end users we interacted with eventually bearing the fruits of our labor. Moreover, there are no service providers in the area, those who have been certified to advocate for the health and wellbeing of the wheelchair riders in a wide variety of contexts. Further user testing by specialists who adhere to global best practices would require the knowledge and resources of wheelchair engineers and service providers. Moreover, there are few actual users in D'kar who we could use to test and market the chairs to on an economically sustainable scale, and the group members who could work on the project are unavailable to stay in D'kar for the time being.

With that said, we decided to wrap up in ways that bring the most value to end users we collaborated with; particularly, by repairing their existing wheelchairs, making housing accommodations to assist with wheelchair mobility with some end users, and to continue follow-up with a D'kar nurse who was very interested in the prototype's possibilities.

Outside of D'kar, we suggested a few alternatives for continuing the project: some members of the program would work on engineering the technology, others would work on the business model, others would work on manufacturing plans in Southern Africa, others would investigate further opportunities through wheelchair research at both MIT and UC Berkeley. Anticipated challenges of continuing the project included how so many actors would effectively continue the project in a variety of ways, if any of the project could be considered new intellectual property that could be protected and determining how team members could eventually test the prototype with actual wheelchair users. An in-depth explanation of the continuity decisions, issues, and contacts are available in the IDDS Hùiku Final Report [188].

Figure 25: Hùiku team [188].

After we completed the intense adult sleepaway camp that was the 2016 Botswana IDDS Summit, we took the eight-hour bus ride back to the capital city of Gaborone. Impassioned by the final week's questions, I began to ask myself: what truly will come of the IDDS outcomes we developed, and what are people's thoughts after the experience? In many ways, many of the outcomes were unexpected. One of the first outcomes was a blog post of the wheelchair facilitators, Matt McCambridge, who described the complex dynamics we approached as a team when aiming to address these ethically precarious, multi-stakeholder, systematically intractable problems in a very short amount of time [189].

After being involved in the project for the past couple of years, members of the IDDS Steering Committee reflected with me on the outcomes of the work. They mentioned how it is useful to develop technologies that could help better their lives, that could eventually be spread to the rest of the world, and how important it would be to sustain themselves and their community through that work. However, further outcomes are even more profound: by continuing to be engaged with IDDS, it is an opportunity for redefining what it means to be San:

"People in the San community are seen as useless…. It's a matter of common knowledge, everybody has seen, defined and understood them as nothing but hunter-gatherers. [We want to show] they are people who can be creative. We are not just only hunter-gatherers. We are people who can be creative with their minds and can share with the rest of the world."

IDDS D'kar Steering Committee Representative

IDDS was also an opportunity, as was said, to also reframe how the San see themselves:

"[We] talked about how we don't need to rely on the old ways... A matter of dignity. [It's also about] Pride in identity & culture as a people…. To be able to do what other people in the world can do: to use their minds to create income!"
"It's a changing of a mindset… it's not a very achievable goal overnight, it's not just a long goal. I want to believe that actions speak louder than words."

IDDS D'kar Steering Committee Representative

Much about IDDS model is similar from the interventions from long ago, such as the focus on entrepreneurship It is also clear, then, that the systems put in place in D'kar offer new opportunities for social betterment, such as the opportunity to create technologies that help benefit the lives of San villagers. IDDS has the backing of international innovation institutions, works to develop tangible technologies that are profoundly influenced by the indigenous knowledge and capacity, and that it aligns with focusing on facilitating San empowerment. One cannot understate the intense work the facilitators put in to ensure that, in some ways, D'kar citizens are left with improved lives: novel technologies, a complete innovation center, and relationships with the Botswana and IDIN innovation communities. Only time will tell that actions speak loud enough to cause deep impact into the lives of these communities.

Outcomes After IDDS

Two years after IDDS, I had the opportunity to follow up with two communities to learn about how they, IDIN, and the innovation communities they developed have evolved. On the international level, the largest change to the IDIN community was the end of the five-year funding cycle they collected from USAID's Higher Education Solutions Network. On September 30, 2017, the funding cycle ended, and IDDS came out with a plan a few months earlier to ensure the essential structures of the innovation community would exist after the funding is over. By the end of the summer of 2017, more than 1,000 participants from 65 countries will have participated in a design summit in some form. In short, the IDIN funding for activities such as grants, innovation centers, training, classes, student travel, entrepreneurship fellowships and summits, and the IDIN central staff at MIT's D-Lab that supports the Network's abilities succeed, would be inaccessible. However, the collaboration identity known as IDIN that "…connects like-minded people across backgrounds, geographies and institutions who want to learn from each other and work with each other on any manner of project, be it hardware or software or research or delivering design trainings" will stay alive [190].

To support the sustaining of this international network, an IDDS Steering Committee was founded to act as the "collective spirit, conscience, memory, and voice for IDDS." The activities of this team are as follows:

- "To solicit, review, and approve applications to host IDDS around the globe;
- To serve as mentors from ideation to evaluation of an IDDS, advising future organizers on best practices around curriculum, projects, participants, organizer teams, community relationships, and logistics;
- To create and facilitate opportunities for cross-learning and collaboration across summits for, maintaining a network of summit alumni around the world;
- To serve as the gatekeepers for the IDDS brand and identity, and as the main points of contact for questions about IDDS;

- To collect, analyze, and share actionable key lessons learned across summits as well as similar programs and models to improve the reach and impact of IDDS; and
- To share the IDDS spirit and approach with a wide variety of stakeholders across the globe [191]."

Mashaba is one of the main stakeholders on the steering committee. Moreover, to support the continuation of the network in Botswana, the community is running yet another IDDS Botswana in 2018; this time, it will be hosted in four villages simultaneously: D'kar, Dutlwe, Rakops, and Kaputura. From July 15 to August 13th, 2018, the forty participants will be developing eight grassroots technologies and their supplementary business models [192].

D'kar also continues to be a hub for attracting national conversations about innovation activity in Botswana. In 2017, BIH executives mentioned how a wide variety of stakeholders celebrated Intellectual Property Day by visiting the village and by holding discussions on protecting and benefiting from indigenous knowledge. They also discussed how the policy design has progressed, the importance of intellectual property, and where people can learn more about the national intellectual property resources.

At the same time, the D'kar steering committee has called upon stakeholders in a wide variety of contexts to continue working on the projects started at previous summits. Mashaba developed a connection with the University of California, Davis and their D-Lab, based on MIT's original D-Lab. To support the development of an undergraduate course, students had the opportunity to redesign the precision planter designed in the 2015 summit, which aims to attenuate more resource-intensive planting technologies that require more plowing, which ultimately disrupts microbial communities in the soil and decreases soil health. The students received grants to visit D'kar and consult on potential methods to develop a technologically ready product. After offering advice on the dispersal mechanism of the prototype, the ad hoc design team had the opportunity to visit the Ministry of Agriculture to receive their backing and support for disseminating the technology. As an organization very interested in conservational food practices, they mentioned interest in subsidizing the technology when it is market-ready. Historically considered underutilized and highly nutritious, the beans support the diet of Kalahari San and other co-located communities and would be an intriguing commercial product. To do so, any product that markets the resource should emphasize the nutritious and organic value, their national origin, and that the product is supporting indigenous livelihood sustainability [193]. In D'kar, the morama bean drink was sent to NAFTEC to determine the types of outcomes of the product and to receive consultation on how to develop a commercial success with the beans.

Another Hùiku team member has also decided to keep the wheelchair project going and has developed plans to sustain the commercial endeavor. To this entrepreneur, the experience at IDDS was life-changing. Before, he came as a genius bicycle repairman, interested in engineering; and after, he became invigorated to rethink how wheelchair technologies could become more accessible in the country. Afterward he enrolled in a wheelchair service provision training course and became a basic provider to this population. He then continued to develop prototypes of the wheelchair and test them with the representative in D'kar. After two iterations, the D'kar villager could move up to two kilometers across the sand by himself. He now has plans to develop his own wheelchair and bicycle repair shop. Because the traditional wheelchairs and the materials they use are usually imported from abroad, he can use the shop to design new mobility solutions in

Botswana using locally accessible bicycle parts. Critical to this shop is also ensuring that the workers are a part of the design process. Also, he will personally train in skills like wheelchair provision, bicycle development business strategy, wheelchair engineering, and the like to spread the model of wheelchair and bicycle design across the country. After talking about how proud I was of his journey so far, I warned him about the difficulty of the road he's currently on. According to him, however:

> "It's worth it because, I'm being myself, I'm doing what I love, I don't care with what they're saying with my work. It makes me a better person, it challenges me."
>
> IDDS Alumnus

It was clear that even the outcomes – wheelchair training, influencing subsidy policy, and community repair – of a single innovation workshop were still unexpected by the seasoned IDDS facilitators. Fortunately, this unexpected nature is expected in design practice. They do not aim to create a linear, predictable plan for a simple and clear future, **but instead they create a breeding ground for a wide variety of unforeseen outcomes.** Though the projects are the points of focus for each of the projects, the innovators have the capacity to take all the lessons from the experience and apply them to their outcomes in how they see fit. This process is what makes the innovation community of IDIN unique: by developing its unique culture, it develops a network of changemakers, who lie on the border of innovative practice in unforeseen ways.

As I left D'kar for the last time, I was lucky enough to find some friends in the area who would help me catch the bus. At 5:15, I left Tautona Lodge, the hostel built for national politicians and conferences in Ghanzi, to ensure I made it back home. The driver took a left into a shortcut, filled with bumpy sand roads dense trees bushes; I knew I wouldn't be able to get out of the bush myself if I was at the wheel. After about five minutes of turns and bumps in the darkness, I saw a soft orange light in the distance. Without hyperbole, we probably followed that light for about five straight minutes, searching for the rest of Ghanzi to come into view. In a way, that last sprint towards the orange glow felt like the light at the end of the tunnel. Once I finally found my way back from the desert where this project began, I finally had the direction I needed to finish this dissertation.

Weaving the extended story of the collection of innovation actors working to find their way has been an exercise in flexibility. As I developed connections with BIH executives, D'kar steering committee members, UB professors, and many other representatives, working to weave a narrative that describes a country's yearning to transition. This tension is present in every innovation activity I've participated in, so the feeling was never new. Innovation actors like the collective of stakeholders I interacted with, who work to redevelop the state of society consistently living on the border of the present and the future. This applies to those trying to set the foundations for sustainably diversifying the economic profile of the country, or those working to develop technologies that represent the culture, vision, and identity of a historically marginalized community. Towards this herculean endeavor, I hope these narratives and insights help these communities with the tools they need to reach their goals. With this, in the next section, I will profile and analyze the evaluation approaches of these named innovation actors, to learn what helps and what hurts, what is aligned and misaligned.

Evaluation Approaches of Innovation Actors

Figure 26: On the road in Botswana.

Ethnography is a complex, time consuming activity. Much of the practical work of this research was made by developing relationships, asking questions, continually trying to be in the right places at the right time, aiming to consistently form ties between seemingly independent communities, activities, goals, and concepts, all to determine insights. In this evolving research space, the research is directed by this research question: **how do innovation actors in Botswana evaluate?** Admittedly, there are many features that can be captured by such a question, including diverging definitions of success, different methods the evaluators trust, different plans for the evaluations' use, different evaluators who use them, and different research worldviews, among other unknown dynamics. The breadth and depth of features became more evident as more data was collected about these evaluation methodologies.

During this research, some stakeholders I connected with learned how evaluation was a disciplinary lens of this research and assumed I intended to evaluate their activities. Let me be clear; I was not researching to evaluate aspects, or the whole, of the innovation community of Botswana. I had neither the motive nor the means, to do so. My focus was instead to determine *how others evaluate*, to determine what success is to these communities and why. This question offers a much broader opportunity for cultural and institutional diversity than a self-directed assessment, and it offers the opportunity to compare other actors' approaches of assessment, how they can be augmented, and to learn what aspects are missing from view.

In presenting this question, I collected and analyzed different evaluation methods of the four main innovation actors of this study: The Department of Research, Science, and Technology; the Botswana Innovation Hub; the Botswana Institute for Technology, Research, and Innovation; and the International Development Innovation Network. Roughly four categories of inquiry were characterized and outlined below:

:

- **What is success?** What values and scenarios does the Botswana innovation community envision and prioritize as outputs for the innovation activities? How do they develop?
- **How do they determine said success?** What evaluands, metrics, methods of data collection, methods of analysis, or program design, are being used by the stakeholders?
- **Who is involved?** Who evaluates, uses the evaluations, and why?
- **Why evaluate in this manner?** What influences the approach to take this form, and what purpose does this evaluation serve?
- **What comes of this?** What outcomes come from the use of these evaluation methods?

Innovation Metrics: Purpose and Use in Botswana

Because the primary focus of this research is understanding how evaluation approaches and outcomes are contextualized in innovation practice and institutionalization in Botswana, it is appropriate to learn about the indicators used to make a case for the importance of innovation on international scopes. There are a few international metrics that Batswana have used to evaluate the capacity of innovation in their country: The Global Innovation Index (GII), and the Global Competitiveness Index (GCI).

As was outlined in the most recent report, the Institut Européen d'Administration des Affaires, or the European Institute of Business Administration (INSEAD) launched the Global Innovation Index project in 2007 to find metrics and approaches that better capture the richness of innovation in society, instead of solely using traditional measures of innovation as the number of research articles and the level of research and development expenditures. The report notes multiple reasons for expanding the purview of innovation metrics:

- First, innovation is important for driving economic progress and competitiveness— both for developed and developing economies. Many governments are putting innovation at the center of their growth strategies.
- Second, the definition of innovation has broadened—it is no longer restricted to research and development laboratories and to published scientific papers. Innovation could be and is more general and horizontal in nature and includes social innovations and business model innovations as well as technical ones.
- Finally, recognizing and celebrating innovation in emerging markets is seen as critical for inspiring people—especially the next generation of entrepreneurs and innovators.

The report does not assume to be the ultimate and definitive ranking of economies with respect to innovation. Measuring innovation outputs and impacts remains difficult, thus the report places great emphasis on measuring the climate and infrastructure for innovation and on assessing related outcomes. Though the report does consider the “end results” of innovation practice, the metrics developed aim to help interested parties improve “the ‘journey’ to better measure and understand innovation and with identifying targeted policies, good practices, and other levers that foster innovation.”

At its core, the Index is a ranking system that collects metrics of many categories of indicators and ranks countries against each other. The ranking gives the countries the ability to see how they fare against others and across the eighty-one indicators. They first split the main index into two

categories: Innovation Inputs and Innovation Outputs, intended upon capturing country-wide contributions and yields that are related to innovation. The Innovation Inputs category contains five pillars of focus: Institutions, Human Capital and Research, Infrastructure, Market Sophistication, and Business Sophistication. Inside the Innovation Output Sub-Index contains two pillars: Knowledge and Technology Outputs and Creative Outputs. The two sub-indices are then combined with equal weight to obtain the collective index. A deeper dive into the methodology is available in the most recent report [194].

The second approach, the Global Competitiveness Report and Index, is published yearly by the World Economic Forum. Like the Innovation Index, it develops a ranking system that allows countries to compare themselves across a vast collection of indicators; though the report focuses instead on what it calls "competition," or the set of institutions, policies, and factors that determine the level of productivity of a country. As a result, it focuses on pillars that instead assume national economies not yet led by indicators considered present in a traditionally innovation-focused economy. As is explained in the report:

> "In line with well-known economic theory of stages of development, the GCI assumes that, in the first stage, the economy is factor-driven and countries compete based on their factor endowments—primarily unskilled labor and natural resources. Maintaining competitiveness at this stage of development hinges primarily on well-functioning public and private institutions (1st pillar), a well-developed infrastructure (2nd pillar), a stable macroeconomic environment (3rd pillar), and a healthy workforce that has received at least a basic education (4th pillar).
>
> As a country becomes more competitive, productivity will increase and wages will rise with advancing development. Countries will then move into the efficiency-driven stage of development, when they must begin to develop more-efficient production processes and increase product quality because wages have risen and they cannot increase prices. At this point, competitiveness is increasingly driven by higher education and training (5th pillar), efficient goods markets (6th pillar), well-functioning labor markets (7th pillar), developed financial markets (8th pillar), the ability to harness the benefits of existing technologies (9th pillar), and a large domestic or foreign market (10th pillar).
>
> Finally, as countries move into the innovation-driven stage, wages will have risen by so much that they are able to sustain those higher wages and the associated standard of living only if their businesses are able to compete using the most sophisticated production processes (11th pillar) and by innovating new ones (12th pillar)."

A country is originally ranked into one of these stages by its GDP and its reliance on mineral and natural resources; measured by "the exports of mineral products as a share of overall exports according to the sector classification developed by the International Trade Centre in their Trade Performance Index."

In the Innovation section, there are two categories: Business Sophistication and Innovation. Besides the Number of Patents metric used in the Innovation pillar, each e metric inside the pillars comes from a Likert-scaled test on a scale from one to seven given out to business owners in the country asking about aspects of the operating environment; thus, their rankings are a collective perception of innovation stakeholders. Depending on how the country's economy is ranked, the innovation and sophistication factors can make up from 5% of the total index score for factor-driven economies, to 30% of the score for innovation-driven economies. A country's economy is defined by its per capita gross domestic product and whether the country has a large majority of its exports from minerals.

How GCI and GII Are Used in Botswana

These two metrics are displayed and used in a wide variety of Botswana media, from policy documents to business magazines, to make the case for institutionalizing innovation. The direct language from the National Competitiveness Report is present in the National Human Resource Development Strategy, where they mention how the country is literally categorized as in a transitory phase, moving from a "factor driven" to an "efficiency driven" economy [111]. BIH's Innogram, a quarterly magazine, mentions the Competitiveness reports from 2013, while noting the reports' focus on the need to increase business sophistication and higher education [119]. Multiple national institutions in Botswana utilize these resources to gather knowledge and inform policy. Tacheba's chapter on the development of Special Economic Zones for Economic Growth mentions the ubiquity of the practice: "Most of what is currently referred to as science technology and Innovation policy nowadays is the experiences and best practices of other countries in terms of the models that have allowed them to prosper or succeed.... International benchmarks and networking on essential part of Science and Technology Park framework development." Towards this aim, the Global Competitiveness Report mentioned the importance of geographic clustering, as critical to inciting innovation: "When companies and suppliers from a particular sector are interconnected in geographically proximate groups, called clusters, efficiency is heightened, greater opportunities for innovation in processes and products are created, and barriers to entry for new firms are reduced." Similarly, Tacheba's chapter mentions how the Global Competitive Report and the Global Innovation Index are used internationally as ranking measures [106]. Additionally, CIPA manager also mentions how the Global Competitive Index is useful to determine the innovation outcomes of this country.

Another function of these analyses is the act of 'benchmarking' – in essence, engaging in research on a topic or area outside of their context, then applying those lessons in the stakeholder's context of interest. The case studies, rankings, and metrics become opportunities to develop policies that are based on other case studies, policies, and countries. For instance, the 2018 Competitiveness Report suggests the most problematic factors for doing business are a poor work ethic within the national labor force, access to financing, and corruption, while the Innovation Index mentions Botswana holds weaknesses in the ease of starting a business, high-tech imports, and intellectual property receipts, when compared to other countries [194]. During these analyses, they also survey policy strategies of other countries and suggest alternatives to incentivize actions that can benefit movement towards the country's goals. Dr. Tacheba has used these metrics in various contexts to advocate for certain policies in the Botswana innovation community. A presentation given in 2017 by BIH representatives to partners in Brussels, Belgium, uses the insights from the Global Competitiveness Index (GCI) to advocate for the development of the national strategic plan, and the Science and Technology Park, among other related activities [195].

However, some of these documents also mention that these indices must be taken with a grain of salt. Budzanani's chapter mentions certain issues of misplaced context for these indicators by suggesting that although global indicators are generally adopted, they do not best represent the local status on the ground. Alternative indicators should be considered to best suit the local situation, and different areas may require different approaches. The African Innovation Fund shares this insight as well: "Often Innovation measurements such as the Global Innovation index are aligned against [African innovation actors], since they focus on Western technology. That should not bother us too much. Instead, our focus should be on his perfect storm of Youth, low barriers to entry, and an open playing field to tackle the real challenges we face in Africa [118]."

These ranking indices and others like them serve to develop a systematic, repeatable, and quantitative representation of the state of countries' innovation and evaluation measures. As is mentioned in the goals of the studies, they acknowledge the evolving nature of innovation as an activity that is not captured in traditional country measures, such as expenditure on research and development and counts per capita of research articles and intellectual property rights. Moreover, both metrics do exceptional statistical work to normalize and standardize by averaging across years, weighting metrics based on their determinable impact in various innovation communities, to "[analyze and assess] the reliability and consistency of the Survey data over time," and they conduct "[tests] to detect statistically excessive perception bias," to ensure the data are verified, believable, and cause influence on innovation in all the countries.

Moreover, the fact that the indices aim to capture metrics that toe the line between capturing alternative forms of innovation while ensuring those metrics are applicable in most countries is commendable. The Innovation Index mentions this paradigm shift about the cause of innovation in its explanation: "Technological breakthroughs were necessarily 'radical' and took place at the 'global knowledge frontier'. This characterization implied the existence of leading and lagging countries, with low- or middle-income economies only catching up. Today innovation capability is seen more as the ability to exploit new technological combinations; it embraces the notion of incremental innovation and 'innovation without research [194]." For instance, the Global Innovation Index includes such output indicators as firms that offer formal training, females employed with advanced degrees, number of joint venture/strategic alliance deals, new business density, ISO 9001 Quality certificates, and intellectual property receipts. The Global Competitiveness Index uses such nontraditional metrics in their innovation pillar such as the quality of scientific and research institutions, the nature of the competitive advantage of the country's companies, or breadth of the companies' breadth in the value chain.

However, there are a few immediate concerns about the applicability of these metrics to innovation contexts. There is a confusion about the evaluand the indices focus on; should it be the country level, or the business level, or senior management in the business? The indices capture information on all three and aim to amalgamate without teasing out paths of influence between the scopes. Additionally, aiming to capture all these metrics in single indices aims to capture the breadth of influential factors in country-wide innovation, but it cannot investigate whether the metrics are aligned with each country's innovation context: one country might use different resources, tools, or policies to innovate than another. Finally, there is no way we can tell how the individual indicators influence each other, nor how the indicators will be directly used by actual innovation stakeholders. Though these approaches are useful as broad, rough country comparisons, evaluation methods also exist that gather insights designed for specific use scenarios. The first example of such an evaluation community is below, headed by the department in MoTE.

Department of Research, Science, and Technology

The primary evaluation activity DRST engages in is to support the data collection, analysis, publication and dissemination of the Botswana Innovation Survey. As is outlined in Botswana's National Policy on Research, Science, Technology, and Innovation:

"Botswana's Innovative capacity will be measured by its ability to produce outputs that contribute to economic diversification and economic growth for the benefit of the citizenry by supporting efforts towards poverty alleviation, employment creation and environmental sustainability. Regular national surveys will be conducted to inform policy formulation, international reporting on Botswana's RSTI system and assessment of the capability of institutions to carry out particular types of research. All research work will be evaluated for quality, relevance, update and impact in order to measure Botswana's innovation capability [108]."

The Survey is also aligned with international agreements to facilitate the development of independent and productive African national innovation systems. This was started by the New Partnership for African Development (NEPAD), was initialized by the 37th session of the Assembly of Heads of State and Government in July 2001 in Lusaka, Zambia. This organization then built the NEPAD African Science, Technology and Innovation Indicators (ASTII) Initiative, which resolved to "develop and adopt common sets of indicators to benchmark our national and regional systems of innovation" from the first African Ministerial Council on Science and Technology (AMCOST) meeting in Johannesburg in 2003 [196]. To support this activity, the partner countries in NEPAD developed the African Innovation Outlook (AIO), a report that outlines the established findings of each country and compares the outcomes to inform policies related to innovation. As reported in the document:

"The challenges are how to link science, technology and innovation to poverty reduction, job creation, sustainable livelihoods and the improved well-being of citizens. How should capacity and competencies be built in order to innovate?"

This document also aimed to address the fact that innovation indicators are absent in the country.

"Most African countries do not have STI indicators or adequate means to produce them, with the reasons for this inadequacy differing from country to country. The lack of STI indicators is of serious concern when evidence-based decisions and policies have to be made [196]."

Internationally, the policy influence of ASTII was beginning to be felt in other countries. According to the second AIO publication, by 2013 there were comparable STI Indicators adopted by at least 30 African Union member states, a flexible and robust ASTII Information system that was built and consolidated; research, development and innovation surveys conducted in at least 10 African Union (AU) member states, at least 30 ASTII national focal points were established and trained in ASTII Survey Framework, ASTII programs established in at least two regional economic communities (RECs) secretariats, and an ASTII monitoring and Evaluation (M&E) system developed and in use [196]. These reports have three broad purposes:

- To support the development and management of science and technology (S&T) policies, and the assessment of research, development, and innovation capabilities of the African continent,
- To provide evidence to advance interdisciplinary research especially within the NEPAD identified socio-economic sectors of education, health, agriculture, energy, ICT, transport, climate change, and others, and
- To provide useful indications on the sources of innovation, costs, drivers of innovation activities and their contribution to investments, production, marketing, profits and firm performance [196].

Measuring research and development activities at the national and regional levels, and the new knowledge and skills generated as a result, will provide evidence to advance interdisciplinary research, especially within the NEPAD-identified socio-economic sectors such as education, health, agriculture, energy, ICT, transport, climate change, and others. The aforementioned innovation indicators also intend to provide useful indications on the sources of innovation, costs, drivers of innovation activities and their contribution to investments, production, marketing, profits and firm performance.

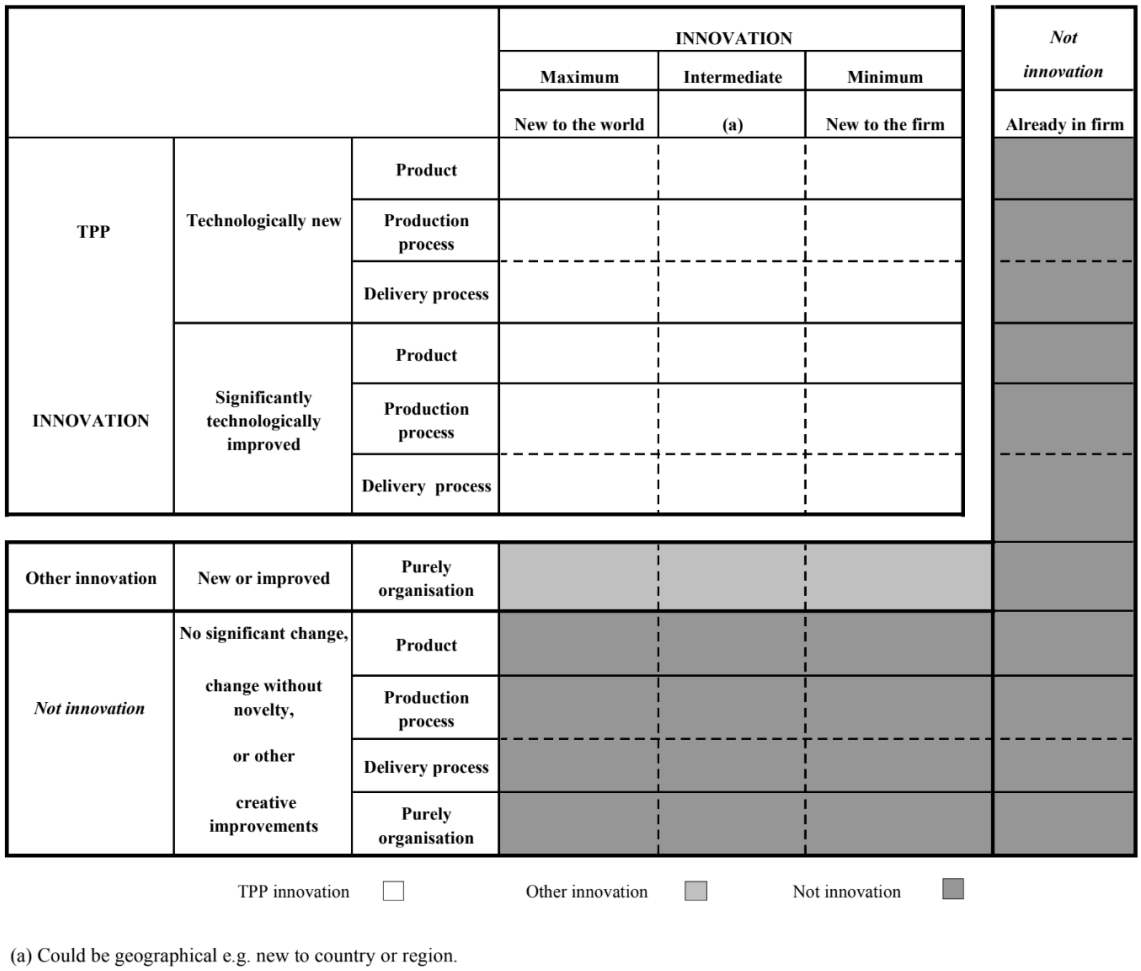
ASTII also decides on, and builds capacity towards, the methodology used to collect the data. These policy instruments were methodologically influenced by the Oslo Manual [197], a document organized by the Organization for Economic Co-operation and Development that aims to develop an international standard for collecting and interpreting technological innovation data [198]. The manual names innovation as an essential consideration in facilitating healthy knowledge-based economies, and interested parties have only recently begun to understand the field with any depth. The primary theoretical influence towards supporting innovation is the works of Schumpeter, which initially stated the theory for the economic incentivization for innovations: firms that are seeking rents.

> "A new technological device is a source of some advantage for the innovator. In the case of productivity-enhancing process innovation, the firm gets a cost advantage over its competitors, which allows it to gain a higher mark-up at the prevailing market price or, depending on the elasticity of demand, to use a combination of lower price and higher mark-up than its competitors to gain market share and seek further rents. In the case of product innovation, the firm gets a monopoly position due either to a patent (legal monopoly) or to the delay before competitors can imitate it. This monopoly position allows the firm to set a higher price than would be possible in a competitive market, thereby gaining a rent."

In the text, they mention three major categories of factors primarily relating to innovation: business enterprises ("firms"), science and technology institutions, and issues of transfer and absorption of technology, knowledge, and skills. To draw boundaries, the manual lists how it only deals with "technological" innovation, which requires an objective improvement in the performance of a product. However, it also understands that there a wide variety of different inputs and outputs that can contribute to the development of new interventions. Thus, it aims to capture technological product and process (TPP) innovation activities as "all those scientific, technological, organisational, financial and commercial steps, including investment in new knowledge, which actually, or are intended to, lead to the implementation of technologically new or improved products or processes [198]."

The manual also develops a hierarchy in understanding the different types of innovations possible: by innovation type (product, process, delivery process, product, production process, or delivery process) and by degree: new to the firm, new to the world, or an intermediate scope between the two. Other types of changes, such as organizational amendments or managerial changes, or things not new to a firm, are not included. A representation of this innovation framework is in Figure 27.

Figure 3. Type and degree of novelty and the definition of innovation



(a) Could be geographical e.g. new to country or region.

Figure 27: Type and degree of novelty and the definition of innovation [198].

The manual decides to isolate the evaluand (the unit of evaluation) to be focused on to be the firm; suggesting that for standardization purposes, firms with under 10 employees should not be included. Also, the manual suggests that "The minimum set of data that would need to be collected in an innovation survey is:

- the type of non-technological innovation;
- the economic benefits flowing from the non-technological innovation activity;
- the expenditure on non-technological innovation activity;
- the purpose of the non-technological innovation activity; and
- the source of ideas/information for the non-technological innovation activity [198]."

In almost all cases, the information gathered to understand this data is done so through a simple random survey of firms inside of a country. The manual also recognizes, however, that it takes a large amount of human capacity to collect data on firms who innovative activities, outcomes, and perceptions. It suggests two major types of types of data collection mechanisms to support this activity: the subject approach and the object approach.

"The 'subject approach' survey **starts from the innovative behaviour and activities of the firm** as a whole. The idea is to explore the factors influencing the innovative behaviour of the firm (strategies, incentives and barriers to innovation) and the scope of various innovation activities, and above all to get some idea of the outputs and effects of innovation. These surveys are designed to be representative of each industry as a whole, so the results can be grossed up and comparisons made between industries. The other survey approach involves **the collection of data about specific innovations** (usually a "significant innovation" of some kind, or the main innovation of a firm) – the 'object approach'. This starts by identifying a list of successful innovations, often on the basis of experts' evaluations or new product announcements in trade journals. The suggested approach is to collect some descriptive, quantitative and qualitative data about the particular innovation at the same time as data is sought about the firm [198]."

Because an essential purpose of the collected data and insights is to inform policy that supports innovative activity in the chosen sectors, many policymakers are more interested in factors that influence the firm and country's market, rather than the tangible innovations made by the firms. Moreover, the subject approach has been deemed data that is easier to collect, due to issues with firms lacking data about the types of innovations they collect. Therefore, the manual suggests using the subject approach to determining innovation activity, and DRST follows this suggestion.

Innovation and development institutions in Sweden also support the facilitation of these evaluation activities through various tools. For instance, The Research Policy Institute (RPI) at Lund University, Sweden, has since 2007 served as the advisor to the ASTII Initiative, providing expertise and quality control in the process. Also, the development of the African Innovation Outlook II was "made possible through the Swedish International Development Coordination Agency."

Botswana has been working to catch up with this continental move to evaluate innovation policy on the national level. It became a member state in 2013 after at least twenty-eight other African countries and did not submit data to the AIO-II survey. The DRST, the office mandated to complete these activities in Botswana, is currently finalizing the development of these outcomes for their own Innovation Survey and the AIO-III and will reportedly have the results available at least by the end of August 2018 [198].

There is a wide variety of standardized metrics the office is collecting for the ASTII innovation survey:

- Product innovation (goods or services)
- Process innovation
- On-going or abandoned innovation activities,
- Innovation activities and expenditure
- Sources of information and cooperation for innovation activities
- Effects of innovation during the last two years
- Factors hampering innovation activities
- Intellectual property rights
- Organization and marketing innovations.

Bibliometrics indicators were also summarized from a bibliometrics study conducted by AOSTI (African Observatory of Science, Technology, and Innovation). The indicators were:

- Number of scientific publications/scientific output,
- Number of publications per capita,
- Growth, impact factor, specialization and citations,
- Scientific output by domain, field and subfield of science,
- Collaboration,
- Characteristics of the most active scientists.

Finally, indicators from the research and development survey were compiled, including:

- Gross domestic expenditure on R&D (by source and sector of performance),
- R&D personnel by level of formal qualification and occupation, gender, headcount and full-time equivalent, and
- Researchers by field of science [196]."

The evaluators are the DRST Officers, and the users of these evaluators are primarily government stakeholders who aim to facilitate and understand innovation practice in the country. They focus on gathering firms with more than or equal to 10 people who engage in business activities across Botswana. As was described, the primary purpose of this evaluation is for country comparability, informing policy across innovation and research:

> "The results of the survey will depict the innovation status of Botswana and thus inform internal policy henceforth as well as communicating the innovation landscape of Botswana in comparison with other countries."
> "With this survey, we are trying to establish… baseline data. Indicators are pointers, showing what is happening, as opposed to your intention…. the indicators are showing where you are, so we can come up with policies or strategies that will tell you where you want to go."
>
> DRST Official

These indicators also have become a foundation for the metrics other national organizations aim to collect; CIPA measures the activity of innovation by collecting data about who files for intellectual property as well. With this information, other national organizations can learn about how intellectual property has evolved in the country through the years and develop further adaptations on the Tswana-inspired knowledge.

Botswana Innovation Hub

Advertised as the one-stop shop for innovation activity in Botswana, the organization engages in a wide variety of evaluation activities to support its organizational mandates. The organization's primary activities are to support entrepreneurs; that includes the support and mentorship of entrepreneurs and the disbursement of grants through the Innovation Fund. There is one main collection of metrics that are used to determine if the entrepreneurs are accomplishing their goals to support these activities.

BIH developed a collection of metrics based upon similar ones used to assess the quality of the startups in the future, based on their work with the African Innovation Fund, which created the Innovation Prize Africa.

"The metrics we set with the IPA, and in essence mirrored it."

BIH Employee

The recently established Innovation Fund works to develop "new and unique products or processes that may be incremental, novel and radical." For a product to be considered innovative, the intervention must be:

- Functionally unique and advanced,
- Efficient,
- Low cost,
- If process driven, it should be a substantial improvement of the original process, and
- Predominantly be the result of technical development as opposed to research or studies and should emphasize technical innovation.

BIH gives examples of potential innovations that fall in this category, including new and unique products with clear benefits, unique improvements to a product, or new software developments that provides substantial efficiency improvements. The innovators must also ascribe to the guidelines before BIH will consider them for funding:

- The project seeks to develop a new product, process or new technical services that surpass existing products, processes or technical services in terms of their functions, parameters or features.
- All Intellectual Property (IP) rights shall reside in a Botswana-registered company.
- Products developed must, where applicable, comply with relevant national and international standards.
- Only one application may be considered from any company at a time. Subsequent applications will only be considered on completion, cancellation or withdrawal of a project.
- The applicant must submit a valid Botswana Unified Revenue Services (BURS) Tax Clearance Certificate at the time of application and for each milestone payment request.
- The sustainable competitiveness or marketability of the product or service in the industry for targeted markets.
- Alignment with BIH industry focus and or call objectives, as determined by the National Priorities for Innovation mentioned previously: Clean Tech, Biotechnology, Information and Communication Technologies, Mining Technologies, and indigenous Knowledge Systems.
- Social and Economic impact including increased taxation revenue, meaningful job creation, increased and value-added exports, increased competitiveness of industrial sectors, increase in highly skilled capacity and knowledge base, lowered net intellectual property cost, increased capabilities for technology innovation, solutions to national needs and improvement in quality of life, and responsiveness to social and developmental needs.
- The technical and commercial viability of the plan [199].

To support the alignment with socioeconomic impact, and the technical and commercial viability of the plan, they developed metrics the evaluators would use to determine competitive startup ideas. After the FSVC process, the entrepreneur gives a pitch and written report on the impact and viability of the project. The executive board asks questions about concerns they have related to the metrics, and after deliberation, gives Likert-scale ratings on five metrics: originality, marketability, scalability, social impact, and scientific/technical aspects. Questions related to each of these categories are included below in Table 7.

Table 7: BIH Startup Success Metrics.

Main criterion	**Criterion breakdown**	**Proposed resources**
Originality	Novelty: a new or existing technology or process.	IP, Tech Transfer
	Ownership: 1 person or group invention; roles and rights to the invention	IP, Attorneys
	Functionality/Applicability: invention usable in industry (intended customer); solves national problems	Engineers, Social scientists
Marketability	Unique Value Proposition: what does the invention offer that existing tech do not offer customers?	Marketing, Business
	Sustainability: are raw materials readily and adequately available? How long before obsolescence/ uselessness of invention?	Marketing, Business
Scalability	Raw Materials: readily & adequately available? Processes and systems affordable? Distribution channels established?	Business, Law
	National/ Regional business protocols & procedures adhered to?	
	Replicable: is business model replicable across nations/region?	
Social Impact	Address customer needs: does it solve their life challenges?	Social Scientist, Business, Tech Transfer
	Job Creator: can it industrialize communities & create jobs?	
	Skills & Knowledge Transfer: can invention or business model improve community skills?	
Scientific/ Technical Aspects	Scientific Correctness: invention designs & support theories based on sound scientific knowledge?	Engineers, Tech Transfer, Scientists
	Functionality: invention can be operated or demonstrated?	
	Product Safety & Durability: safe for human use during operation? Not emit toxics & hazardous elements? Not a once-off operation?	

These tools are successful under the assumption that the evaluators can determine the startup's capacity in each category. The evaluation team discusses each of those responses as a team, but they develop their scores as individuals. Certain consultants mentioned how this deliberative activity might be difficult, as the evaluators might not agree, nor be sufficiently knowledgeable

about the field to determine its impact accurately. The BIF will then provide financial support to proposals based on merit. If they agree on the capacity of the startup, they then will promise a maximum of BWP 500,000 (about 50,000 USD) disbursed in periods over a few years. If they fund the startup, it is then evaluated based on its ability to reach certain milestones of progress, to determine if it should continue receiving support. These include:

- Company must be commercial and have at least one repeat client,
- Presentation of Financial records,
- Demonstrable development of the business or project,
- An appreciable level of innovation,
- There must continue to be a good record of working relations from the pre-incubation program (if transitioning from the pre- incubator program), and
- A team must have the requisite technical skills to undertake the business/project.

The data collected to determine these milestones include:

- The baseline assessment of companies at enrollment,
- Market,
- Product/services,
- Business processes,
- Financial information,
- Information about the team,
- Facts about the ownership of the program, and
- monthly feedback meetings with services providers/mentors and clients [200].

To support these activities the organization also sets metrics to monitor its own progress of the mentorship program and the innovation fund. For the mentorship program, they gather data on the number of companies receiving dedicated services from the program, whether the organization reached the milestones it set in the pre-incubation, incubation, and acceleration parts of the project, the number of key interventions like pitch sessions, funding that the clients have collected, and the amount of capacity building sessions they have held. For the fund, this includes collecting data about the applications for funding, the number of application grievances, the milestones achieved by the projects, the procurement exercises engaged in by the project, and the number of government milestones achieved. As mentioned, they also help to set milestones for each startup they support, which is a collection of goals related to the strategic plan of the years of progress of the startup. Organizations that have reached the level of milestone tracking include a saline water treatment project and a solar testing and demonstration facility [199].

The program also records data on recruitment and citizen inclusion into the BIH community. BIH employees discuss how they informally collect data on who they reach, and the percentages of innovators who progress through the pipeline.

> "For the people that I talked to...Did they inquire to the program? [The next step], Did they apply to the program? After they joined the program, did they commercialize their product and graduate out of the program, and are now mentoring people in the program?"
>
> BIH Employee

Over time, the total outcomes of the organization are amalgamated and presented to the President's office and the collective public through the annual report. They present the advancements of the organization over the year, available to citizens all over the globe.

BIH is developing resources that help facilitate the growth of successful entrepreneurs across the globe, and only time will tell how well they reach their goals. One quality that seems to be missing, however, is how they fail to mention resources focused on adapting to the pressing needs of the entrepreneurs themselves. Innovation entrepreneurs already mention how they need more than just Wi-Fi and the ICON building, and as they progress, those needs are likely to adapt and change as they strive to reach new heights. As a catalyst, BIH must develop resources that ensure they keep an ear to ensure their facilitation grows with those needs. Another issue that arises is how BIH manages expectations and communicates progress. Many governmental stakeholders were endemic to the develop of the institution, and internal stakeholders have mentioned how they expect speeds of growth outside the scope of any innovation ecosystem. These BIH employees must be clear about the about the nature, needs, and activities of BIH as the institution moves forward; not only to manage expectations, but so the policymakers--and the rest of the country--can become more innovation literate.

Botswana Institute of Technology, Research, and Innovation

The evaluation activities discussed by BITRI stakeholders aim to support the research, development, and commercialization of the technologies under development at the Institute. There are two main approaches addressed: the activities developed by the BITRI design team, and the approaches of the BITRI's Executive Board. The design team engages in co-productive design and evaluation activities that facilitate the evolution of the products as they interact in real-life environments. Many stakeholders have mentioned how the organization "...embod[ies] the idea of co-creation" in their practice, including members from a wide variety of backgrounds to facilitate the holistic development of the products, and they are interested in facilitating opportunities to include those stakeholders in the process.

> "There should have been an integrated collaboration between somebody who runs with the technology, somebody who develops it, and somebody who would use the technology. That's not yet happening, because there is that gap of communication, of education between each other…. Here we have researchers, the scientists, the engineers, the designers. But, you also need the psychologists, the social workers, the other finance, managing, the marketing… those, we don't have here."
>
> BITRI Executive

The design team engages in a litany of tests to facilitate technological development, from field visits, to user testing, to feasibility studies, to needs assessments in the country, to technological prototyping & testing. In this, the metrics considered evolve based on the guidelines, the context, and the geography they visit. Also, during the process, the team is open to narratives that can better inform positive outcomes in the future. For instance, BITRI design members explained how they are investigating lighting solutions around the country, and they collect data and stories on topics as wide ranging as issues with security, if injuries have been decreased, if children are reading or doing homework, and who can do business due to the improved lighting. In these early-stage projects, the team is looking to determine how 'depth' and 'type' of change in people's lives is important, rather than the 'spread' of change. These pieces of information are used to augment the

technologies, and to defend or modify the vision of technologies once it has been made technologically ready. The team also mentioned the social considerations of connecting with end users, and how the design team manages those issues during the design, collection, and evaluation processes.

"We have to make sure it is doing what you want it to do. [We] must make sure it is safe. [We must] allow the person that you're developing the design for, allow them to use the product. Don't let them feel afraid, so they have control over... so that the user can use it comfortably…

"It's actually very good to [involve end users in the process]. We usually get an honest response for what you're trying to do… when you get then from the onset, and focus on what needs to get done… sometimes you're going in the wrong direction…"

"What can you experience in a simulation sometimes, and most times, is not what you will experience…. [We might] do a paper model and show people…. We want to catch the first reaction."

It's never easy, because sometimes they think you're trying to challenge their intelligence.... And they don't think it will benefit them…"

We try to get them as comfortable as possible. We try to get closer, and somehow, we hope…"

BITRI Design Team

The design team is a critical part of technological development from the inception of projects, and works to ensure the look, form, shape, and interaction with the technology will be smoothly integrated into society. These insights are disseminated to the head researchers and the other members of the board consistently to work to evolve each BITRI technology.

Before a technology is ready for assessment by the rest of the Executive Board, the lead researcher determines the progress of the project. When they consider it ready, the creators of the technology have to also file an Intellectual Property Disclosure Form and supporting documentation, a form that "...document[s] their Invention and provides key information regarding the Creator(s), funding used to develop the IP and the rights of third parties, for submission to BITRI Research and Partnerships Division for assessment of the Intellectual Property."

To reach the mandate of commercializing six technologies and earning 40% of its revenue by 2020, the board aims to develop technology that is commercially marketable, globally novel, technologically feasible, and impactful in some form or fashion. The evaluand are the technologies, and the evaluators is a board collective: the executive director of BITRI, the Director of Research and Partnerships, the Manager of Technology Transfer or Designate of the position, the Manager of Finance, the Lead Researcher on the project, and another external member the members above want to include, such as a legal expert, a national intellectual property manager, or another expert in a related field. When a technology is considered ready to be evaluated, a presentation is given on the technology's capabilities and is assessed based on three broad metrics: its novelty, its technical feasibility, and its marketability. Baked into the process of evaluation is the research required to assess if the plan is feasible, and many questions are asked of the project's design team.

"What is it that I've done in this tech that is new, novel? How can we protect this technology? Now we're getting into IP issues. Now I have the prototype, will come back to us. We leave to do tests…How will we scale it up? Who can take thing and run with it now? We are not a manufacturer, we need to come up with commercialization strategy. [Do we do] licensing? Spin off? Joint venture? Another Business?"

BITRI Executive

To ensure the team has a standardized list of indicators, BITRI uses an amended Invention Evaluation Form to gauge the likelihood that BITRI can consider an invention for intellectual property protection. Though the form they do use was confidential, they did mention that boilerplate forms available in online searches served as the foundation for their current work. Such a form asks questions as follows:

- *Building & Use Cost.* Is the invention cheaper or more expensive to build and use than current products?
- *Weight.* Is the invention lighter or heavier than current products if important?
- *Size.* Is the invention smaller or larger than conventional products?
- *Safety and Health Factors.* Is the invention safer and healthier than what is already known?
- *Speed.* Is the invention able to do a job faster or slower than conventional products?
- *Ease of Use.* Is the invention easier or harder to use than conventional products?
- *Ease of Production.* Is the invention easier and cheaper to manufacture?
- *Repairability.* Is the invention easier to repair than conventional products?
- *Novelty.* Is the invention different from conventional products?
- *Convenience and Social Benefit.* Does the invention make life easier and more convenient for the consumer?
- *Appearance.* Does the invention have a better or worse appearance than conventional products?
- *Precision.* Does the invention provide greater precision than current products?
- *Noise.* Does the invention operate more quietly than conventional products?
- *Market Size.* Is there a larger market for your invention than for previously known devices?
- *Difficulty of Market Penetration.* Is the invention an improvement of a previously accepted device? (If so, it will have an easier time penetrating the market than a completely new product.)
- *Quality.* Does the invention provide a higher quality result than existing products?
- *Long Life Cycle.* Does the invention have the potential for being sold for many years (10 years or more)?
- *Satisfies Existing Need.* Does the invention satisfy an existing, recognized need amongst consumers?
- *Production Facilities.* Does the invention require new production facilities or only a modest change to an existing production facility?
- *Crowded or Wide Open Market.* Are there few or many existing competitive products [201]?

These assessments are all compared to products in the existing market, where a positive number on a Likert Scale means your product is more competitive, and a negative number means the product is less competitive. As described on the website:

"If the "cost" to build and use your invention is much more expensive than conventional products you should give that factor a score between -50 to -100. If the "weight" of your invention is much lighter than conventional products you should give that factor a score between +50 to +100. If the overall size of your invention is not important to consumers you should give that factor a score of 0 as not applicable [201]."

Using these resources, the Executive Board deliberates on these issues within thirty days:

- "How the IP meets the objectives of BITRI,
- How the IP may be of benefit and contribute to the socio-economic needs and competitiveness of Botswana,
- The extent to which failure to seek such IP protection will compromise the achievement of BITRI‟s objectives,
- The extent of readiness of the IP for protection and whether any additional research and development needs to be undertaken before IP protection can be obtained… [202]"

The Board then decides if BITRI should support the project and develops a plan to do so. This process includes finding funding for the projects and planning commercialization procedures: filing intellectual property documents, producing a clear marketing plan, and pursuing external partners who are primed to manufacture, market, or otherwise sell the technology. One concern of the BITRI Board is how many researchers are not knowledgeable about the importance, nor the logistics, of developing intellectual property, and how promoting a broader literacy of those topics will better align research outcomes with business-focused inputs.

BITRI is a brand-new institution with aggressive goals and living up to them is no easy task. As a research institution, developing an institution for Botswana, by Batswana remains a difficult task. To accomplish its tasks, the stakeholders must ensure there is clarity in the institute's purpose. At this point, the institution might be working to serve two goals at the same time: competing with international research and development houses, and developing technological, market-based solutions for Batswana. Though globally competitive researchers and facilities could serve those needs, the country is still dealing with the small-market problem. When educating researchers about intellectual property and while developing marketing and commercial relationships, BITRI must remain vigilant that they continue to serve the country's citizens, lest their slogan of co-design practice becomes an empty promise.

University of Botswana

At the UB, the office that aims to leverage knowledge into innovations is the Office of Research and Development (ORD). The office engages in various tasks, such as:

- "recruitment of post-doctoral fellows,
- setting up a quality framework for planning,
- conducting and disseminating research and assisting faculties and Departments to implement that framework;
- establishing a structure for ethical compliance by all researchers across the institution and assisting all entities to implement it and to correct research misconduct;
- establishing partnerships for collaborative research;
- offering training in research management to academic staff and graduate students;

- developing a funding strategy and funding guidelines for supporting research by the faculty, academic Department, research institutes, research centres and the individual researcher; and
- commercializing research outputs through developing intellectual property policy, guidelines and commercialization strategy [203]."

Like other actors, the evaluation resources are related to the commercialization and social outcomes of the knowledge developed by the institution. As of this writing, the document that outlines how research can evolve into commercial outcomes is the University of Botswana Policy on Intellectual Property, finalized in October 2004, that aims to "provide a mechanism for enabling discoveries and ideas created within the University community to be developed into products available for the benefit of society, and for any resulting income or rewards to be shared fairly between the stakeholders." During the data collection process, the University was internally discussing the next iteration of this policy, which will be made public in the next couple of years.

The document outlines concerns that UB staff must consider when developing intellectual property protection. Those that are required steps for the inventor are listed below.

- The IP must be original.
- The IP must not be made known to the public before the patent is filed. Once a discovery is announced in public it can no longer be patented (e.g., if a researcher tells people about his or her ideas, then this is announcing the IP in public, unless there is a confidentiality agreement).
- There should be proof that the inventor made the discovery (e.g., a laboratory notebook with validated dates of entries).
- The owner of the IP must be made clear [204].

The University policy has also served as a foundation for organizational policy for similar bodies in the country throughout history.

"UB is the big university, everyone is looking up to us for everything. Even all the other institutions are newer, so when we meet, they always ask us… for guidance. The capacities of UB can be shared…. Our tools can be public when we have them."

University Director

As of this writing, the ORD office itself cannot monitor or evaluate the outcomes of the workshops. It is still setting up organizational capacity to suggest various outcomes for UB researchers, which manifests in the office covering a wide berth in offering outcomes to university stakeholders:

"We are trying to cover everything, Creative fields, they don't come up with products, they come up with art... Engineering and Science come up with inventions. Social sciences they come up with cultural policy.
Market analysis [and patentability] we can't do because we don't have that here, but it can be reasonably outsourced…. The idea is to host the Technology Transfer Office at BIH and have everyone else have access to it."

University Director

The largest institutional concern at UB is the sparseness of resources that might facilitate innovative practice in the country. Over its nearly four decades, it has clearly built research, human capacity, and institutional knowledge about the issues, context, and potential solutions to the country's issues. However, the capacity cannot be effectively harnessed until the resources exist for it to do so. The purpose of the ORD is to determine how knowledge creators can get more from the same research they have been conducting, so it can increase its benefit on society. However, the limited capacity of the office makes it difficult to get everyone on the same page and interested in facilitating knowledge. Over time, with more human and financial capacity, the office can engage in its consultative and evaluative roles along with the rest of its many mandates.

International Development Innovation Network

IDIN has developed a wide variety of resources, programs, tools, and networks that aim to facilitate the evaluation of their collective activities. As was mentioned before, the resources aim to focus on the development of co-creation activities and foundations by focusing on resources that support the people, the projects, the products, and the process of IDIN as a collective. When the Creative Capacity Building theory and framework was outlined in Taha's 2009 thesis, it suggested the consideration of possible metrics during IDIN activities.

> "Specific evaluation criteria within four main categories is needed:
> **Technology creation and use**: documentation of the tools, machines and process improvements created by workshop participants.
> **Behavioral changes**; inquiry into broader social developments catalyzed by the presence of livelihood technologies, e.g., new forms of collective action, increased pursuit of adult education or training opportunities, or adjustments in the division of labor between men and women.
> **Attitudinal shifts**: exploration of themes such as self-awareness, self-esteem, confidence in oneself or one's community to affect change.
> **Economic impact**: calculation of the economic impact of livelihood technologies, including changes in income level and opportunity costs [157]."

Designed and managed by Laura Budzyna at MIT's D-Lab, the evaluation system and approaches developed into a cohesive and multi-pronged system that served a litany of data collection, analysis, monitoring, mentoring, and facilitation purposes [205]. At its peak, they facilitated a multi-tier evaluation system at every level of influence: at the international level at the global office, at IDDS summits and related activities, for workshop participants and workshop teams, and for local IDDS chapters. The purpose of these collective activities is to develop the holistic progression of the actors involved in an IDDS intervention, including the people, the teams, the technologies, the networks, the design methods, or other unexpected outcomes of the design process.

On the global level, IDDS uses a wide variety of different approaches to advocate for and facilitate the development of the network. The office uses these data for a wide variety of contexts: to report to their funding agencies, to gather knowledge about the consequences of their activities, and to monitor the collective activities and outcomes of the community. Much of the data and the processes used to collect the data are made available through publications like the IDIN Program Impact Report that covers theories of change, the collection of activities, and a collection of diverse metrics that show the program's influence [206]. As was mentioned previously, data is gathered internationally on information including but not limited to the solutions developed, the network members involved directly through summits or indirectly through IDIN influenced activities,, the

countries they come from, what participants value most about the summits, what knowledge or skills they gained from the process, the amount of investment raised by partners post-funding, the ways IDIN supported current solutions, how IDIN members spread its approach, and how network members connect. Collecting these various metrics aims to capture the many ways the Network influences and catalyzes co-creative innovation.

IDDS is also open to evolving how it gathers and understands the data it collects over time, as well as external evaluators offering different lenses that can investigate IDIN influence. For instance, the randomized control trial on income, welfare, and attitudes in Uganda intends to examine the impact of the program on economic impacts, attitudes and behavior, and spillover effects [80]. Additionally, researchers at the Tufts School of Law and Diplomacy developed and analyzed social network maps based on one-year post surveys from the Colombia and Botswana summits in 2015 and 2016. Through the analysis, they found that:

> "1. Innovation centers, advice, and connections are the most impactful components of the network. Participants with the most network connections (i.e., the largest nodes) were more likely to engage with innovation centers and take advantage of advice and mentorship of other IDIN members.
> 2. IDIN members who attended two or more summits give back to IDIN in multiple ways. Participants who attended more than one summit in the same country (larger nodes) were more likely to volunteer with IDIN than those who attended only one summit.
> 3. After IDDS, participants tend to either "work on an innovation or venture" or "spread the approach," but not both. There were two different types of participants who accomplished their goals: those focused on new products or services, and those focused on teaching design and co-creation to others [207]."

The office also holds space for developing evaluation knowledge and tools with funders and grantee organizations. Examples include the Metrics Café, design by IDIN's umbrella organization the MIT D-Lab, a toolkit for facilitating conversations between donors and grantees on deciding on a plan for collecting impact metrics. The toolkit offers different plans for metrics collection and reporting while comparing the consequences of each and including considerations to blend the needs of both parties [208].

To facilitate the collection of data, IDIN sends a selection of monitoring and evaluation fellows from a wide diversity of graduate school programs to collect data on participant experiences and aspirations during Summits. The global team offers masters students in a wide variety of contexts to work as facilitators and to head the design, implementation, analysis, and communication of useful data in the area. While collecting the data, the students gain the opportunity to investigate a novel form of development practice, gain first-hand experience with the complexity and intensity of assessing co-design, and to be mentored and led on an internationally structured evaluation team. Alumni from the evaluation program spoke about the quality of the global evaluation system as well:

> "[It's an] amazing system that [IDIN] has developed, making a system which is measuring the learning, with the participants themselves…"
> "...[I] Got very lucky in terms of support…"
>
> IDDS Evaluators

Before each of the summits, the global office held meetings to ensure the colleagues were knowledgeable about the vision, mission, and activities of IDIN, the resources they had built to help start the evaluation process and assisted them in the process of developing their own IDDS evaluation plans. Although there were specific metrics and indicators IDIN requires the evaluators to collect for comparison purposes between and across workshops, the community was also very open to novel metrics and methods to collect useful data. For instance, at IDDS Colombia 2017, where the topic of focus was climate change, the evaluator decided to collect data on what the participants believe climate change is, and how it impacts their lives. An IDDS evaluator at Sisaket, Thailand, saw how different stakeholders were interested in using the IDDS program as a catalyst for further co-creation activities by local actors, so the evaluator focused on capturing community interest and enthusiasm. Also, as a secondary goal of studying environmental sustainability, the evaluator collected data about the amount of human waste each of the participants made as they participated in the summit by weighing the feces produced by the entire IDDS team. Though a wide variety of tools were facilitated to collect this data including surveys, team discussions, and open brainstorming, surveys were the main manner of data collection.

At each of these workshops, the focus was to determine the holistic impact of IDDS. The data would be used to monitor the IDDS, to see how it has changed or adapted to the process, to see how projects have changed, to determine how participants have changed, to collect and spread knowledge about the workshop, and to make a case for the multitudinous forms of impact for funders, including but not limited to USAID's HESN program.

At IDDS Botswana, the monitoring and evaluation plan was designed to ensure the questions at hand would support the activities during the summit, and the data needs of the global office.

Table 8: IDDS Botswana 2016 Evaluation Plan.

Why?	What?	How?
To observe if the summit is being implemented according to our standards.	Logistics, Amenities, Support	2 Mid-summit Surveys, During the Summit
	Curriculum and Schedule	
	Project, Team	
	Activities	
To observe if there has been a short-term impact on IDDS Botswana participants.	Attitude/Perspectives	1 Pre-Summit survey (Baseline), at Beginning 1 Post-Summit Survey, at End
	Skill/Knowledge	
	Plans Post-Summit	
	Goals/Aspirations	
	Self-Assessment	
To observe if there has been a longer-term impact of the summit on I DDS D'kar 2015 participants.	Behaviors	1 Follow-up Survey, 10 months after IDDS 2015
	Support (IDIN)	
	IDDS/IDIN Connections	
	Impact on Work/Career	

Feedback, Learning, and Outcomes boilerplate surveys used at IDDS summits are available in the Appendix. The formative evaluation metric categories included the logistics of the program, amenities, and support given, the curriculum and schedule, the progression of the project, and activities engaged in during the summit. Each of the activities completed, from lectures, food, and housing, each skill taught, the possible influences IDIN has on the participants' future work, even the goals people have both before the workshop and for using the resources after activities have completed, are all covered in the evaluation materials. Specific summative evaluation questions included the changed attitudes and perspectives of design practice, the how the participants perceive that skill and knowledge of design activity, the plans of the participants after the Summit, and their goals and aspirations after the Summit, through pre- and post- summit surveys. These surveys used various question methods to gather data: open-ended format questions, quiz questions with right or wrong answers, self-assessment questions with Likert-style answers, and multi-answered questions. The IDDS evaluators reported the final outcomes for the workshop to the global IDIN office and made the findings available to the global community through monitoring and evaluation blog posts on their website. Posters that also showed the outcomes of the mid-summit surveys were made available to the participant community during the summit. They are available in Figure 28.

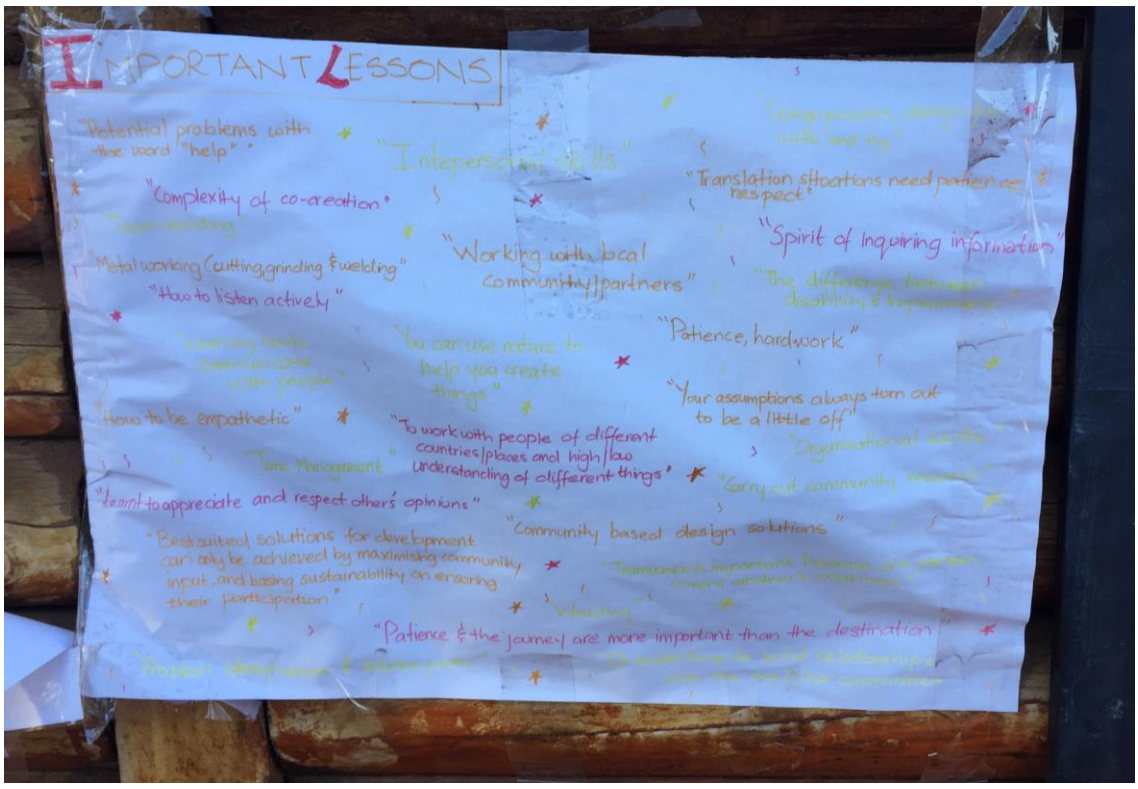


Figure 28: Monitoring and Evaluation Mid-Summit Outcomes.

Figure 29: Monitoring and Evaluation Mid-Summit Outcomes.

One future evaluation direction that was mentioned by global IDDS stakeholders was the development of approaches that align mentorship activities and monitoring approaches simultaneously. Though the process needs further development, the vision is to develop strategies that support the development of IDIN network members, local chapters, or local technologies while simultaneously collecting data the organization needs about its activities and outcomes.

The facilitators and the IDDS participants also have formal tools used by the design participants intended to further development of the projects during the design workshop. The most discernible evaluation method used during the approach is the Design Requirements Chart. After collecting the customer and user needs for the technology to be developed, the design teams can turn those needs into goals to be met by the potential technologies. In this process, the group collectively decides what to measure, then they decide how it will be measured, and then they decide on a range of acceptable values. Having a range acknowledges the compromise inherent in this portion of the design practice; how the prototype will likely excel in some metrics and less so in others. A few categories are suggested for all projects, such as affordability, safety, and ease of use. A blank frame of the Design Requirements chart is shown in Table 9, and the one Hùiku developed for the wheelchair is in Figure 30. The purpose of these tools is to isolate metrics that can be used to gauge technological development of the ideas through various user testing activities, to assess prototypes and set standards to learn from for future prototype iterations.

Table 9: Design requirement metric development tool [187].

Design Requirements

(Work on your project's design requirements here.)

User Need	What are you going to measure	How to measure it (units)	Good Value	Better Value

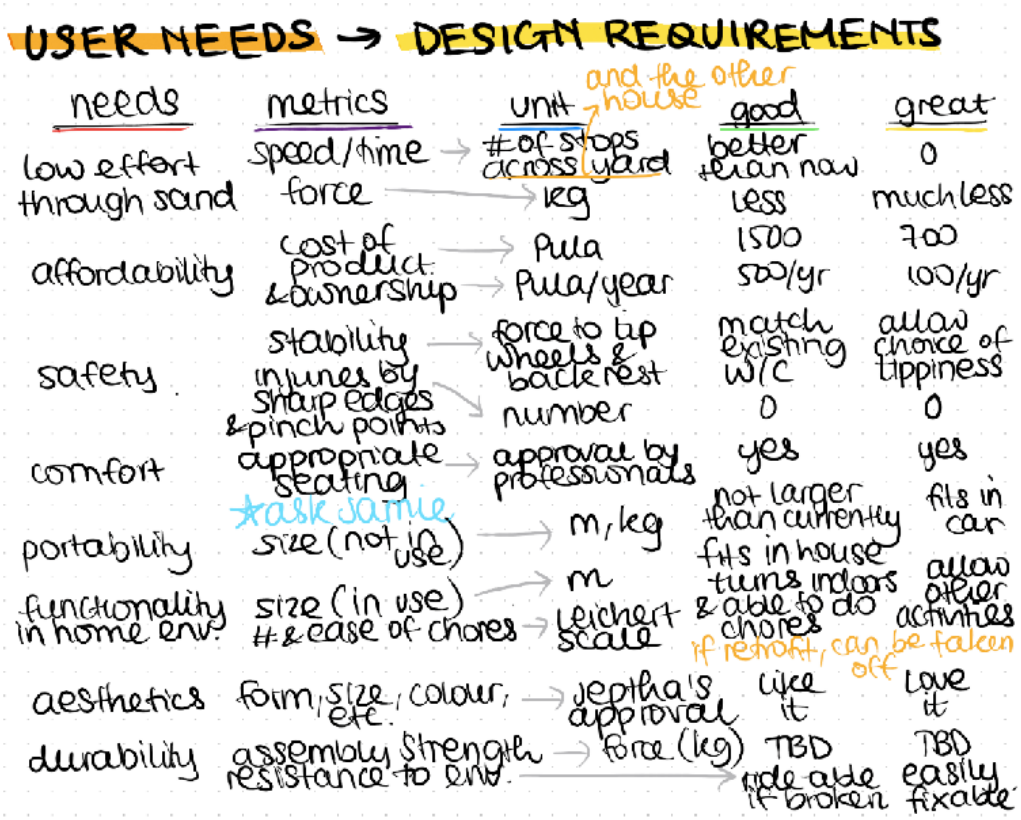


Figure 30: Design requirements for wheelchair.

After the metrics are chosen, they can also be used to compare prototypes themselves. IDDS offers two similar methods; the Pugh Chart and the Concept Evaluation Matrix. These methods compare potential or prototyped design alternatives across the previously developed metrics. Each design alternative is judged as better, worse, or comparatively similar in each metric category, and the values across categories are added to a final score to determine the quality of a specific design. In a traditional Pugh Chart, the new designs can be compared to the existing designs or to each other, and the new designs are only given a plus for better performance, a minus for worse performance, or naught for neither. The design teams can also test the metric categories across prototypes if the resources are available to do so, or the numbers can be obtained by team deliberation; in the Seronga CCB and IDDS, we came to consensus through participatory voting. The Concept Evaluation Matrix is only different in its ability to weigh the scales; instead of only using pluses and minuses, it uses numbers that can be used to weigh the metrics. When determining the comparative numbers during IDDS, we used a scale from one to five, with three being the same as the current technology. The metric weights, shown in Figure 31 as the Importance Coefficient, can be weighed based on how important it is to metrics of success, ranging from one to ten. Finally, the final values at the end of the scale serve as approximations for technologies that are likely to be successful at accomplishing the desired goals; but care is taken to ensure that the designers take the final values with a grain of salt and final deliberation is used to decide the types of technology used to make decisions. Included below in Table 10 is an example Pugh Chart and below that in Figure 31 is the Concept Evaluation Chart from the wheelchair project.

Table 10: Concept evaluation chart [187].

	Criteria	Datum	Option 1	Option 2	Option 3
Specific					
General					
	Total				

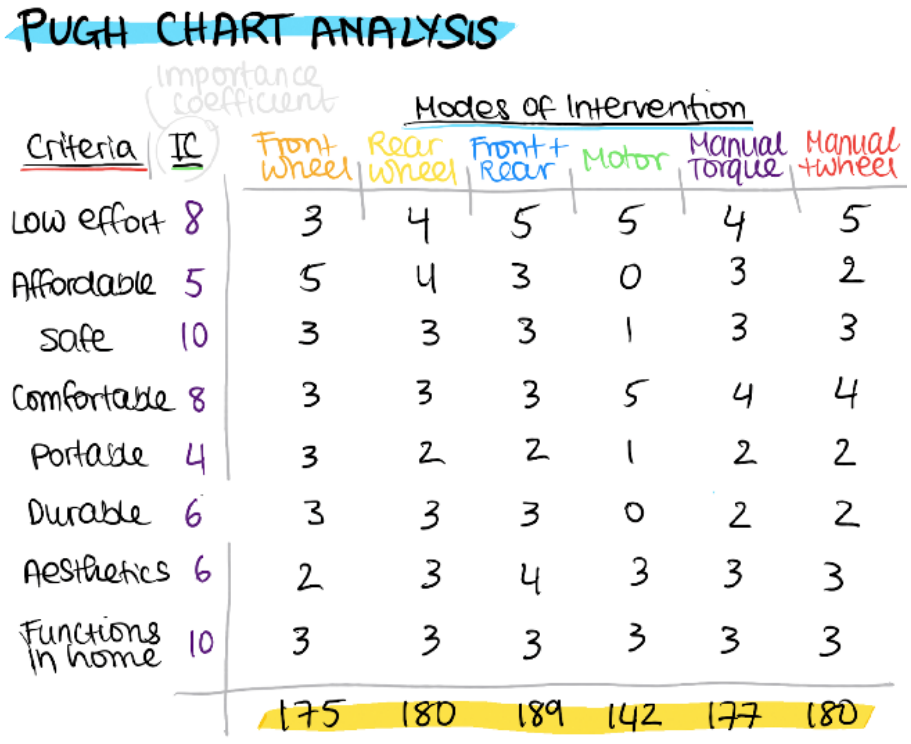


Figure 31: Wheelchair concept evaluation chart.

Though the scale does add and subtract values that have no physical magnitude (e.g. the difference between a score of 3 and 4 does not mean the same as a difference of score between 4 and 5), and though the metrics that usually differ qualitatively are forced to be compared quantitatively, the method serves to force comparison in order to make decisions about strategic direction for designers who have minimal time and resources. This method also offers the opportunity to compare the offerings of different designs across the critical design indicators. The evaluations are included in the IDDS workshops and are passed down to the project heads after IDDS.

There are also simpler evaluation frames that were used for testing early-stage technologies, through the development and discussion of metrics that represent technological development. During the Seronga CCB, the teams aligned with the Chili Crusher project looked for ways to determine if their technologies would be better than the existing solutions. The team discussed how the fine powder would get into eyes, hands, and other sensitive areas, better technologies would potentially cost less, crush faster, and would keep the fine powder more contained. As time was the primary consideration, they developed a goal of shaving down the time to crush twenty-five kilograms of chili from thirty minutes to fifteen minutes -- in essence, to cut the time in half. A picture of a chili crushing prototype developed at the CCB is in Figure 32.

Figure 32: Prototype chili crushing technology from Seronga CCB.

The IDDS facilitators also teach the participants a litany of different tools that are necessary to engage in useful evaluation of technologies and projects. They conducted lectures on data collection, understanding research, information gathering, developing a field strategy, testing tools and techniques, synthesizing said information quantitatively and qualitatively, refining user needs, and on getting and documenting user feedback. These lectures are taught to be immediately used by the design teams for the summit, and the teams can use the approaches however they see fit as the summit progresses. To ensure the participants had a few simple questions to drive them, they suggested these categories of focus:

> "WHY: What are the research goals for community interaction?
> WHAT: What information do you need to address the problem better?
> WHO: Revisit your stakeholder analysis – Who would you like to talk to in the next couple of days?
> HOW: Observe, ask and try. Can you come up with 2 or 3 ways to gather information towards what you need?"
>
> IDDS Facilitator

Information data collection that supports evaluative thinking occurs during many different activities during the summit. During the early information gathering phase, data is collected concerning the lifestyle, setting, activities, relationships, technologies, and much more of the end users and analyzed for its importance and relevance to the project vision. Before each data collection activity, we made sure to prepare ourselves with questions about what we can expect: What will we ask? Who will we see? How do we split up the jobs? Whose capacities are bred for which tasks, when coming together to do the jobs? What is your current state? What is your preferred state? Who else should we talk to? How far away are they from the center, using the map of the area we printed? This was done by introducing three broadly construed data collection methods: 'asking' questions, 'observing' surroundings, and 'trying,' or tangibly interacting with the people, tools, and community in contextually appropriate ways. For example, we visited the plot of end users pushing their wheelchairs, asking about how they get from place to place, and watching for tools and resources in the plot of land, and we tested pushing and pulling his wheelchair ourselves to gauge the difficult of the act.

We also received advisement about ensuring we make the process comfortable and ethical. For instance, we talked about how pity for the end users doesn't help to resolve these issues, as it causes designers to over associate the end users with the problems. We also discussed who speaks when, how we interact with different people, and reach consensus on how we ask for consent. The facilitators ensured that we didn't promise anything to the potential end users during data collection; because the D'kar has had a history of unequal distribution of the many development interventions, ensuring we enter the space without promising outcomes we cannot deliver on was critical. To prototype our information gathering plan, we had the opportunity to test our data collection plan on another IDDS team, as they did on us, and receive feedback on those plans.

During the sketch modeling and prototyping phase, the products to be developed act as catalysts, both for the designers and stakeholders of the end community, for further understanding of potential prototypes to be produced during the workshop. When learning to understand the physical characteristics of designs or design details, developing prototypes offers the opportunity to see in practice how certain technologies work. By including members of the community, it leverages an opportunity to show them what the design teams have accomplished and to give

feedback on the evolving technology. The incentive in this space is to facilitate technological development that is better informed by the context of the users, while simultaneously developing simpler, cheaper, more beautiful technology to make it more accessible and user-friendly. For example, during the community design review, we developed a wide variety of prototypes and generated a collection of questions that would critically inform how the mobility solutions can be further improved upon. The questions are in Figure 33.

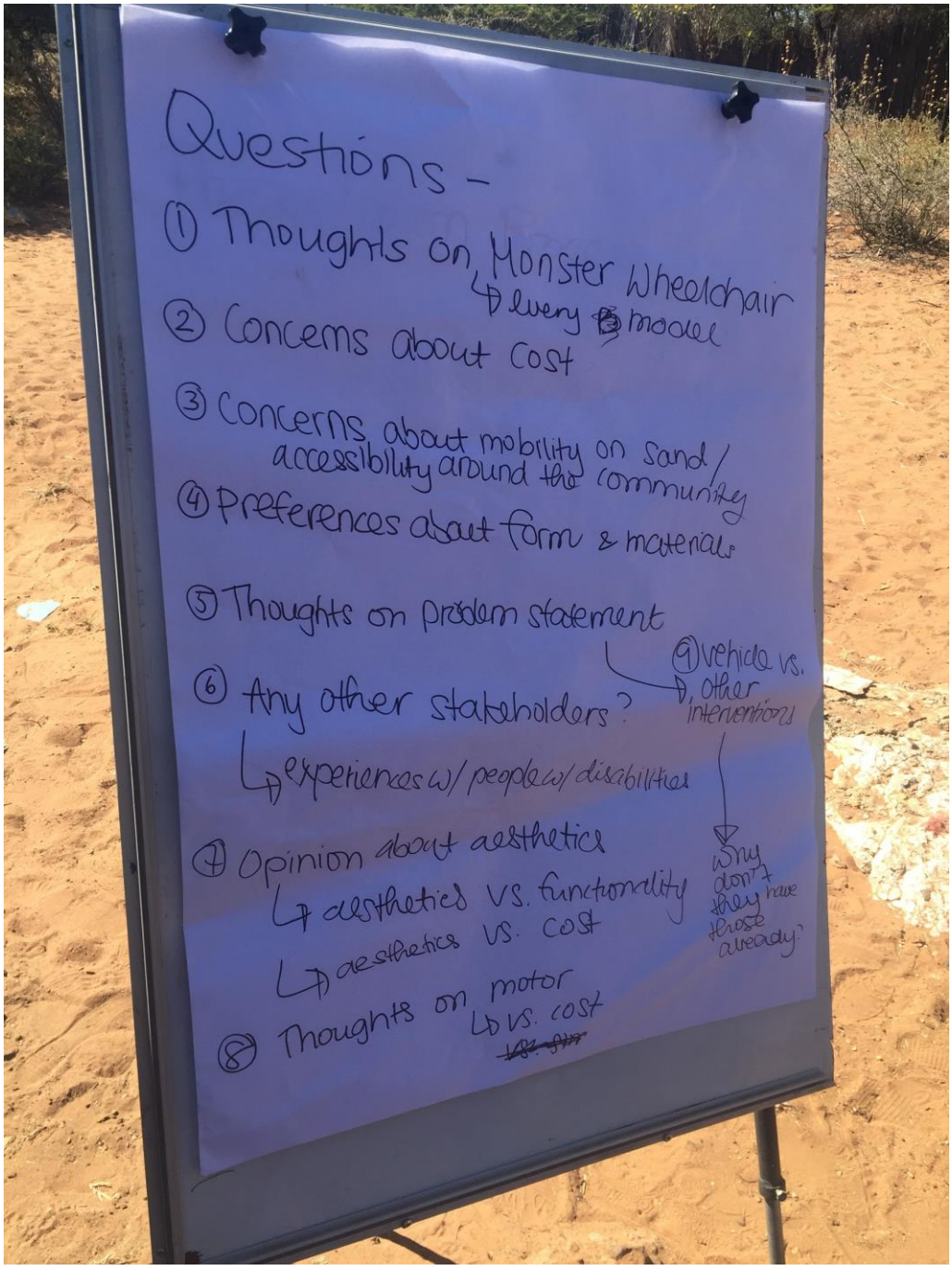


Figure 33: Questions for community design review.

By developing tank treads out of wood and string, I learned how standardized the tech needed to be and technologically complex the technology was; and how we could not develop such tools for one wheelchair, much less a manufacturable line of chairs. This was an exercise in making, failing, and learning from the experience. Another example is the development of the 'big wheel' chair; we had the idea to use car tires instead of bicycle wheels to see if the increase in flotation would move better across the sand. We then put a simple desk chair on the chair to test the prototype's ability to take our weight, and many D'kar citizens became involved in the show. After pushing the chair for a few minutes, however, we found it was too hard for a rider to grasp and move the big wheels with their hands, and many of the villagers told us how the chair looked ugly with big wheels. These activities evolved into opportunities for learning and adaptation of our design for the future. Other innovators who visit D'kar experienced learning activities in similar ways as well. The University of California Davis students who further developed the precision planter said they used the CCB methods to inform their data gathering and prototyping process. They brought prototype precision planters developed in California to D'kar in their suitcase and evolved the products through prototyping. After they got back to the United States, they also took video of the newly amended prototype and sent it back to the IDDS Steering Committee to demonstrate how the product functions. Pictures of some of the prototypes for the 2016 IDDS workshop included in Figure 34.

Figure 34: Prototypes developed for community design review.

We also tested the prototype during the final workshop, when the wheelchair proof-of-concept was completed. A wheelchair owner tested our wheelchair in the church and the sand and gave us feedback on its ease of use. Though we did create a wheelchair that takes less effort than existing solutions, it also did not push far across the sand. With this understanding, we had to consider alternative models than the ones developed to make it easier to push the chair.

Near the end of the workshop, we also had an opportunity to engage in a technical review of the technology as well. This evaluation method is useful for designers who aim to broadly critique the technical consequences of the prototype, to learn how to create a more quality technology on the next iteration. To do this, the team collected the facilitators who could offer expertise in the field, and collectively deliberated on goals attained, visible and unintended issues with the existing solution, and technical opportunities for modifying the technology. These insights would then be used to better inform interested parties in developing the tech in the future.

For instance, the wheelchair team had a technical review where we collected all the facilitators who had wheelchair expertise, expertise in ergonomics, in manufacturing the technologies, and related disciplines. We discussed how although we accomplished the goal of moving through the sand with less effort, we did so with appreciable compromise. The final chair had pinch points and sharp edges; chairs must be as safe as possible and forgetting this on the final prototype reflected how our tunnel vision when addressing issues of effort robbed our team's ability to consider other safety issues. There were also unintended consequences of our modifications: because we welded two tires onto each other, the chairs had to be pushed by the tires instead of the rims, which could be an issue when the chairs picked up thorns during travel. Moreover, the larger profile of the chair made it much more difficult to fit through doors and to get the wheelchair up and down large stoops, making the wheelchair only accessible on the outside.

The technical group offered design alternatives such as different profiles of sand flotation. We also learned a user experience insight for further testing; that applying force while outside the wheelchair is different than being outside the wheelchair, so doing force testing on different wheelchair configurations requires people in the chair, pushing or being pushed. We also were offered technical suggestions related to how the chair is moved, such as introducing gears to support mechanical advantage changes.

The summit also offered space for the team to design user testing alternatives for the technologies. The teams could support the learning and development of the next generation chair with data about the operation and mechanical characteristics while we had access to the sand-based context we wouldn't have access to after the summit. For the wheelchair project, we determined the user tests by our capacity to perform the test and the limited amount of time we had to conduct them during the last few days of the workshop. The question we asked of ourselves was, "What do we want to know for project continuity, right now, in the sand?"

We deliberated on a wide variety of tests that could determine changes in performance of the chair. These included tests of fatigue (how long can a rider move across the sand without getting winded), and tests of effort (how much force is required to push the chair through sand). The tests were stratified by whether they could be done independently in the chair, or with an attendant, and with various configurations of the chair: with no modifications, with double-rimmed wheels, with levers, with extended front wheels, and with multiple configurations of all three. Altogether, we developed plans for conducting thirty-six separate tests. A diagram made in the field that differentiates the tests is in Figure 35.

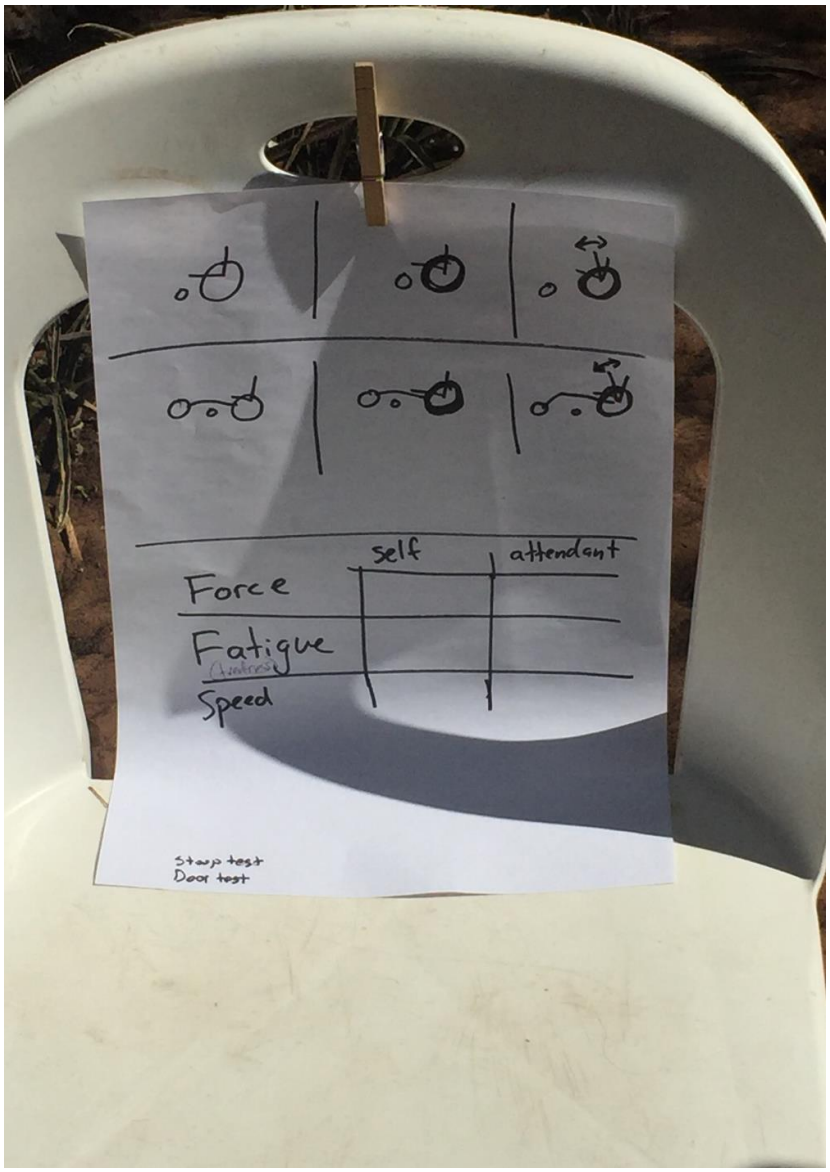


Figure 35: User testing framework developed by wheelchair group.

We decided to conduct only two of those tests: how much effort is used to pull a wheelchair without our modifications, and how much with our wheelchair assembly, to see if there was a difference in effort. Though pulling the wheelchair with no one inside is not similar enough to independently pushing a wheelchair, the test was enough to show there was less effort required for the prototype chair. While developing this prototype, each lesson we collectively developed in the earlier stages of design contributed to the collective knowledge of the types of interventions that might work for the future; for example, the expertise built during the development of the Monster Wheelchair with car tires helped us answer questions about the different flotation profiles during the technical review. The user needs developed near the beginning also gave designers an opportunity to latch onto important considerations when continuing the design of the project; for instance, ensuring the wheelchair's aesthetics continued to be agreeable to the wheelchair riders, and making the wheelchair safer in the future by ensuring we got rid of pinch points and sharp corners, remained a critical consideration for future designs.

There were also open opportunities to reflect on the nature, quality, and influence of the workshop for us as individuals and as a team. Overall, open reflections offered opportunities to broadly look back on the experiences, to think about the influence of activities during the summit and to empathize and discuss relationships between actors: participants and facilitators, participants on the same team, participants and IDDS, and participants and themselves. The most common of these activities were semi-regular team check-ins, to ensure the team was cognizant of different dynamics while working together. Called a heat check, intended to check the 'temperature' of the team, the simplest way to start the process is by asking the team: "How is everyone feeling about team dynamics?" These self-produced metrics were based on categories community members considered pressing, including microaggressions, rifts in communication, contrasting working styles, issues of marginalization including sexism or ageism, or issues between individual partners. The summit also offered the opportunity for open reflection on their experience as a methodological alternative to the regimented feedback of the survey. The open feedback avenues let participants draw, write, or develop whatever they wanted on their piece of paper to reflect on their experience at the end of the workshop. Included in the process was the opportunity to reflect in multiple groups openly about the overall experience. These methods offered the opportunity to hold space for thoughts, comments, concerns, critiques, or appreciations that hadn't been covered by the other workshops.

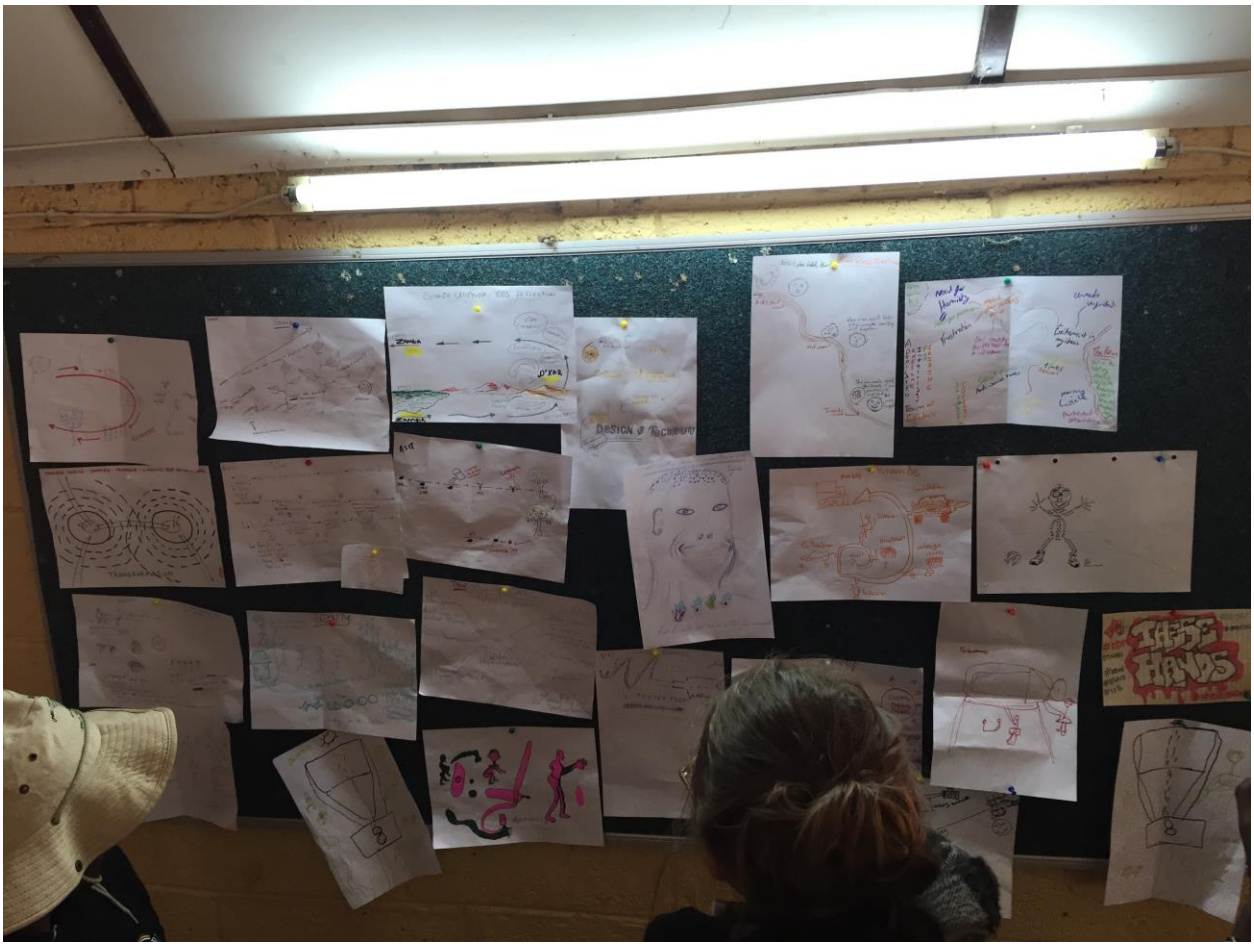


Figure 36: Open reflection of IDDS workshop.

Finally, resources were utilized and disseminated to the IDDS community to help sustain innovation activities in the future. The IDDS Global office created a workshop that teaches innovation center managers about how to evaluate the impact of their CCB workshops. The workshop introduces the idea of why the community should care about impact in the first place, offers a framework for a theory of change for Innovation Centers, holds space to determine outcome metrics that support their intended impact, and demonstrates a few methods to collect insightful data about the CCB experience. During the workshop, the community agrees upon a theory of change, traditionally in the form of "If we teach CCB to students and community members, then…", and collectively develops a theory of change. To determine the outcomes, the workshop facilitator asks the participants to think of people they directly work with, how these stakeholders might be affected by CCB workshops, and what they hope people will do because of the workshops. These goals are categorized into outcomes for CCB participants, and outcomes for organizations. Examples of participant outcomes from a CCB workshop include people working on CCB projects, participants using the projects themselves, or participants teaching others about CCB, among others. Examples of organizational outcomes include supporting local innovators, and adopting and promoting the CCB approach, among others as well. They then develop a collective theory of change based on these insights. An example theory of change is as follows:

> "If we teach CCB to students and community members, then participants will continue to **work on** their CCB projects, **disseminate** them to people who can benefit, and **use** them for their own benefit. They will **apply CCB skills and ideas** in their daily lives, and they will **teach** these ideas to others. The organizations we work with will provide more **support to innovators** and will **adopt and promote the CCB approach** in their own work. Together, this will contribute to a world with **improved access to technologies** that improve people's lives, a **stronger local economy**, and a **nation of innovators** and problem-solvers [208]."

Also, they learn about "Most Significant Change" Technique to use in their evaluation activities; in short, they ask what the most significant change they've seen after a CCB and ask why the story is important. The participants also categorize success factors and barriers towards successful CCBs that might come from the participants, the context, and the implementation levels.

The next workshop is then held the next week, which gives the participants the opportunity to collect data using the questions they collectively created. Apart from the aforementioned metrics developed by the Innovation Center community, information was also collected on who the CCB alumni talked to, how these new stakeholders found out about the CCB, what they expected when they started, what CCB goals were for the new participants, what they can learn from the process, what their first impressions were, and their most memorable moments and takeaways. The purpose of this activity is to build the capacity of innovation centers to understand, spread, and plan their evaluation plans to support the strategic development of the centers. The center steering committees use these methods to develop their CCB strategic plans and theories of change, and the data from the workshops are also disseminated to the IDIN global office to gather data about appropriately trained local chapters and to utilize the data they collect about the influence and spread of the CCB programs.

Finally, the program also offers opportunities for evaluation and data collection on the workshop level from outside collaborators. During the Seronga CCB, one of the professors brought along the students under the intention of learning from the experiences of the students and other participants.

"We need to collect data on making a case for something like this... we both need publications. So, if we could flex data that can serve multiple purposes, making the argument at our home institutions, helping students know what they know… [we are studying] the evaluation of student learning."

Seronga Facilitator

By collecting research journals, the students write in each night, the professor leverages the opportunity to apply educational learning theory to the CCB context, to determine the impact of the workshops.

To ensure the innovation community has resources that usefully and clearly introduce tools and methods that support the collaborative design of development-centric technologies, IDIN has ensured the tools are understandable, accessible and useful to as many new development-centric designers as possible. These qualities are present in the evaluation methods as well; each tool is collaborative, understandable, and applicable to many different communities, and can be used to create many different technological solutions. However, participatory innovation is not a panacea for the historical ills of the San, and the tools and methods reflect a beneficial yet incomplete solution set for the San context. The methodological influences of the innovation and evaluation tools are grounded in Global North mentalities that prioritize ubiquitous approaches to development. IDIN's theory of development, for instance, is to catalyze a million designers who design solutions to their own poverty issues worldwide, and the IDIN evaluation resources support that theory and definition of success. Though the focus is grassroots-led, bottom-up, and participatory, this approach, like many others in the country, is still comparatively blind to the systemic, historical, and ethnic nature of the oppression experienced by the San as detailed by Saugestad. Creating interventions in this context is no easy task, as IDIN is aligned with the visions of Botswana-led institutions, and they clearly work to navigate the political space in a way that ensures they sustain those relationships. In doing so, the innovation actors run the risk of making San identity assimilationist and nonrepresentative of San values.

Lessons Across Scopes

The evaluation activities listed above, international and local, focused on people and products, are used in a variety of ways. There are many insights to glean out of the evaluation methods approached here. There are three categories of insights below: how the approaches are aligned, how they are misaligned from each other, what these actors could learn from each other.

How Evaluation is Aligned

One clear focus of innovation practice in Botswana is the development of institutions that innovate to create commercial outcomes through products and services in the global marketplace. The country aims to support Batswana to develop commercial outcomes and evaluate how well these aforementioned institutions aligns with this priority. This is also aligned with the economic foundation of innovation practice initially theorized by Schumpeter, where rational economic beings in the marketplace innovate to 'seek rent': whether to create intellectual monopolies, to gain reach over a new or existing market, to increase the yield of the firm or other commercial reasons. The international metrics aim to determine how innovation supports competition across countries, using the firm as the area of focus. The issues plaguing Botswana intend to leverage international and local knowledge to build institutions that address the litany of entangled problems in the future, including unemployment, overreliance on the diamond industry, exploitation of

cultural knowledge by other countries, technological issues of clean technology including water and energy, and others. For IDIN, the priority is to support indigenous communities in locally produced co-design; IDIN has developed a global ecosystem that supports a litany of needs for these entrepreneurs with the aim of developing independent commercial businesses that address their many poverty-adjacent issues. An additional goal is to have their indigenous knowledge and expertise valued on the international scale and personally feel worthy as global innovators.

In this form, however, this definition excludes a vision where social, organizational, policy, or otherwise institutional innovations are prioritized. Though there is institutional alignment between the metrics and evaluation methods at different scopes, this decision precludes the possibility of supporting or investigating methods, tools, and outcomes that aren't tangible products in nature, but are still summarily designed. Innovation can and is practiced in government, in nonprofits, and in academia, towards outcomes to better human and environmental life; and in these examples commercial outcomes isn't the only answer, but one of multiple methods that can deepen and scale impact. In Botswana, the boundaries of innovation determine the goals the citizens believe can be addressed using these institutions. The evolving innovation culture in Botswana has drawn a boundary of innovation practice: one that is technological and novel, where success is worthier if it is globally directed. An important concern is that *the innovation developed by Botswana institutions might lead to solutions for which the Botswana context is an afterthought*.

What is also similar, however, is how these four institutions that aim to assess and analyze innovation in the country recognize their new and evolving nature. If evaluation remains a priority in the future, the tools these actors develop will evolve as the community becomes more mature.

How Evaluation is Misaligned

Though these evaluation approaches matter, certain misalignments must be mentioned and addressed if the breadth of innovation facilitation and practice is to be appropriately analyzed. One example relates to the data frame of innovation evaluators. As mentioned previously, the Oslo Manual aims to capture the development of innovation practice on the level of the firm, as they are considered the actors that have the highest capacity, the history, and the incentive to innovate. To give countries, regions, and continents the opportunity to compare the activities, outcomes, and perceptions of innovations, the methodology draws boundaries on the firms that should be included -- for standardization purposes. Thus, the Innovation Survey excludes firms with less than ten employees. What is unique about this exclusion in the context of this analysis is that the activities of the Local Innovation Center are excluded from the purview of this study. Including Mashaba, the head of the center, in the Business plan established for the D'kar Innovation Center, there are nine registered people in the organization:

- Nicodemus Barkard,
- Jacob Camm,
- Joseph Dii,
- Tabaxae Kaashe,
- Mathambo Ngakaeaja,
- X'gaiga Qhomatca
- Komtsha Sixpence, and
- Naxabe Xgaiaga.

Any activity or outcomes from the organization on this level would thus be excluded from a rigorous implementation of the ASTII innovation survey. However, the issue at stake is broader than merely this single exclusion. In Botswana, the informal market is clearly represented through entrepreneurs who support their families through subsistence products and services. Batswana clearly engage in a large variety of informal economic activities, and the insights and knowledge of these communities and their contexts is not supported by these innovation institutions. *Before these communities can be supported, they must be a part of the discussion*. Fortunately, NEPAD, and DRST, as a result, are interested in developing tools that survey innovation in the informal sectors. A DRST officer mentioned how a large population of entrepreneurial activity in Botswana happens in the informal sector outside of firms, and that as of this writing, NEPAD is currently working to develop resources to systematically survey those populations. To start the process, however, the community wanted to ensure some innovation measurement was occurring, and using existing resources developed through NEPAD was considered enough for the time being. NEPAD, however, has the rare opportunity to collect data that simultaneously tracks and benefits the informal sector. To do this effectively, a completely new collection of metrics, data frame, data collection methods, use case, and intended outcomes must be designed, one that collaborates with national institutions that have experience supporting the needs and overcoming the obstacles of the economically insecure.

What We Can Learn from Each Other

In many ways, these data in this dissertation are a survey of innovation tools and evaluation approaches with larger context about who uses them, for what purpose, and why. These tools can be applied, augmented, and re-developed for each and any of the innovation actors both inside and outside the country. However, these institutions have much to teach each other about the priorities, realities, and purposes of evaluation innovation that should not be lost in the fold.

For instance, the evaluation resources of BIH could be adapted to learn from the holistic, evolving, and participatory approaches of the IDIN Botswana community. A critical focus of the Hub is to build the capacity for, and accelerate, entrepreneurs towards independent commercial outcomes. The First Steps Venture Center takes the entrepreneurs through an in-depth process of planning, consultation, research, and development to develop market-ready businesses. Therefore, the tools outlined in the dissertation tools can help startups to evaluate more effectively, set and amend their theory of change, establish a plan for data collection, gather data and analyze, determine evaluation use criteria, test and manage team dynamics, and much more.

Moreover, BIH can learn more about how the process of participatory innovation practice endemic to Creative Capacity Building naturally uses methods of evaluative thinking and practice. IDIN activities serve as an important case study in how evaluation activities only remain useful if they adapt to the context the evaluators need; innovation, for example, requires infrastructures that are adaptive, emergent and dynamic. As the innovators collect data, develop ideas, and consult with communities, the design team is consistently evaluating nearly every activity they are innovating. In the early stages of design, **design thinking and evaluative thinking are inextricably linked**: learning to juggle different design values, assessing and using the data developed, developing plans for success and proceeding strategically towards those goals, and searching for intended and unintended consequences of their actions. However, the evaluation approach is neither linear nor regimented, where the purpose of activity is to see if previously set goals were attained. What evaluation does do, however, is facilitate innovators learning about unintended consequences and

stakeholder needs so those insights can be adaptively used to create beneficial technologies. In this, innovators must not be tied to existing metrics and present approaches of investigation, but to future evaluation approaches that develop needs that are yet to be understood.

However, IDIN doesn't stop at increasing the evaluation capacity of their entrepreneurs. The IDIN network collects and utilizes data internationally and locally about their technologies, their entrepreneurs, the funding they acquire, the relationships they build, and how they spread the IDIN approach. IDIN aims to capture the many different ways innovation activities can influence the world; and plans are designed to gather, investigate, and utilize the metrics towards many purposes: to inform the community members during and after the workshop, to monitor and develop the design of innovation summits for the global office, to test and spread the technologies, and to support the future funding of the community and their programs. Moreover, IDIN also evolves their evaluation plans and approaches as they progress, either by including evaluators with different capacities or by adding useful data themselves. Even then, certain outcomes, like influencing subsidies for local innovation of national organizations and increasing the number of houses repaired next to innovation centers, are unexpected and welcome. The development of tools that establish the worth of innovation activities requires constant learning and development.

An important question is this: why should the innovation institutions learn from the evaluation system developed by IDIN and its satellite institutions? An answer comes from the CCB experience in Seronga. It was clear that there were various goals from the innovation workshop, and many of the goals of the collaborators aligned with the goals of the workshop. However, we should never forget the role of power in determining priorities. IDIN had both the institutional knowledge to develop and utilize these evaluation resources, the CCB approach that was tried and tested, stakeholders that trusted in the relationships and future outcomes, and the resources to develop outcomes and utilize them as they saw fit. In short, IDIN's evaluation activities leveraged their institutional power to further their various personal goals. The clearer and more aligned the evaluation approaches are, the more capacity an institution must have to navigate towards their own definition of success. The prime lesson for institutional actors is how *evaluative knowledge is power*. If innovation institutions do not use these tools, they lose the ability to accurately gather capacity to reach their goals -- potentially, at the benefit of competing institutions.

However, the IDIN Botswana community has an opportunity to learn from the evaluation approaches utilized by the national organizations as well. One critical activity to be established at each of the innovation develop institutions -- UB, BIH, BITRI, and others -- are technology transfer offices. They help facilitate relationships between these institutions and issues with innovation once they leave the purview of a single institution.

> "[The office] exists to assist Innovators and Inventors in the commercialisation of their technological ideas, products and services. This entails a thorough break-down and interrogation of such in-coming inventions for possible IP protection, assisting with drafting of any IP claims made, identification of existing manufacturing partners, or in their absence, facilitation of creation of Spin-off companies to up-take the research results, assistance with commercialisation, licensing, encompassing Non-Disclosure and benefit sharing clauses, stakeholder management, and general dissemination of info on Intellectual Property and Tech Transfer [211]."

Once a technology is ready to become commercialized and is intending to become globally impactful, the expected next step is to protect technologies through intellectual property policy. However, IDIN offered little discussion or resources about how local entrepreneurs should protect their ideas and prototypes. Admittedly, there are valid debates about whether certain beneficial technologies *should even* become protected through IP laws, because the technologies might not be as open source as they are now, and such a complex discussion is beyond the scope of this dissertation. However, the San and Botswana have a tensioned history with exploitative innovators, and the country has resolved to develop policies that aim to develop advocacy and benefit-sharing protocols to ensure such exploitation never happens again. Without this protection, the San communities and many other local innovation communities that IDIN works with would continue to be vulnerable to intellectual exploitation. The Seed Innovation Africa Book mentions how documenting innovative solutions of communities like the San remains a gap.

> "Grassroots Innovations are generated by indigenous entrepreneurs, who attempt to solve problems in their environment or find alternative low-cost Solutions when existing ones are unaffordable. They meet the needs of underserved populations and foster social inclusion as they tend to be both affordable and sustainable. They also tend to employ greener Technologies and techniques. Ignoring indigenous knowledge therefore means leaving behind a valuable Wellspring of breakthrough solutions for modern society. As the saying goes, "many of the problems we struggle with today were solved by our forefathers. They just did not document them [118]."

How does this issue intersect with evaluation? Notwithstanding all its inadequacies, intellectual property remains the global standard for determining innovative contributions by a country, organization, or community. A plethora of global organizations utilize intellectual property laws to support their work. Being included as an innovative organization offers the opportunity to show the global influence of certain IDDS innovations. If national surveys include the knowledge and resources from local innovation communities, other global innovators can learn about -- and evolve from -- their innovative ideas. If IDIN and other related institutions aim to be a hub for facilitating participatory innovation with and by impoverished people, they must offer structured advice and available resources to protect locally produced innovations.

Analysis and Discussion

Figure 37: materials for wheelchair prototype.

"They say it takes 10-15 years for a science and technology park to begin to bear fruit. We are established at a time when there's a lot of pressure. I told you 10-15 years when we get to see tangible results…. We know the woman to have a baby, that it takes 9 months. It's almost that we deliver our child in three months. That's the kind of pressure we are under. We must be mindful of the economy in which we work."

BIH Representative

I remember the first time I stepped into the Botswana Innovation Hub, after developing a relationship with a few of the representatives through the organization. As the established one-stop-shop for innovation activity, it seemed apropos that I develop strong relationships with the communities from whom I was intending upon learning. As I moved from person to person, however, I found the topics they mentioned during the interviews very intriguing. After I finished with most interviews, I then asked them in what ways I could make the research useful to them and their work. I obtained various answers to this question, but they mostly revolved around a single theme: "So, what do you think about the innovation ecosystem? What issues does it have, and what can be done to make it better?"

At first, this question caught me off guard. It was difficult to explain that most of my work wasn't going to be completed for at least a few months because any superficial answer I immediately gave wouldn't give them the answer I felt they deserved. Secondly, it was hard to explain that, with my focus on a related, yet different research question, I couldn't adequately answer such a question without a concerted team of researchers. After I learned about how the UNESCO GO-SPIN publication required eleven separate researchers to design and implement the project, my incapability became even clearer. Lastly, to ensure my work would be better received and to ensure cultural openness, I entered the field work with the assumption that I didn't have the answers they sought. However, the fact that question was so omnipresent taught me two lessons. First, this community wants immediate, useful, and trustworthy insights to help with the institutional performance at all levels. In short, they need research and evaluation now, not later. Second, it revealed how fast the innovation community is evolving, learning, and changing.

These insights showed me a critical inadequacy of the capabilities of traditional academic research: for a community that evolves daily, research that takes years to develop might not serve the immediate and changing needs of my respondents, and arguably might become less accurate over time. To support this insight, I resolved to consult, communicate, and learn from my findings as I navigated the innovation space. I did this in a few ways: I gave a guest lecture to a graduate level survey course in learning evaluation, I facilitated design workshops at the Botswana Innovation Hub that focused on addressing gaps of catalyzing social capacity, and I delivered a seminar to the BIH C-Level employees focused on broadening evaluation perspectives. Fortunately, these activities gave me further opportunities to test insights, learn more stories, and gain more understanding of the capacities and struggles of this fledgling ecosystem. In this adaptive, learning environment, I analyzed and documented these insights during the entire process: as I planned the study, as I collected data, even as the dissertation was completed.

To support the needs and precious time of my colleagues, **I aim to report outcomes and insight about the innovation community that are not addressed in other research publications.** For instance, a critical concern of many Botswana innovation actors is how innovators in the country desperately need funding, including research grants, angel investment, technological prototyping support. Though I could mention these topics as insights in my research, these outcomes in my dissertation would be redundant: the UNESCO GO-SPIN study outlines in depth the very same problem across the innovation landscape [96]. Moreover, over the past few years recently inaugurated institutions such as BIH and HRDC have recently started funding programs to address these very issues. A few issues, including innovative capability, a shortage of critical skills, and low participation of the private sector, are aptly included. To complement these recommendations, I intend to search for insights about the evolving ecosystem that lie beneath the policy improvements: from potential tensions in perceived Batswana culture, to innovation as an institutionalized form of development projects. When I broach topics that that exist in other published recommendations, including clarifying and cementing indigenous knowledge protection and support, I intend to dig into existing cultural tensions that are likely to hinder beneficial innovation practice. Below are the collective insights from the analyses conducted on this ecosystem.

Cultural Concerns and Influences

One pressing concern of a wide variety of innovation stakeholders is the cultural tensions that are perceived as obstacles to facilitating, practicing, or studying innovation. These tensions are present in various ways.

One way this reveals itself is through language tensions. The most straightforward issue is the fact that there is not a simple translation in Setswana that represents innovation as a concept. The words that Batswana use most broadly are *bonokopila,* which more closely translates to excellence, and *maranyane,* which translates to technology. The head translator during IDDS used the Naro word *sonkori*, which more accurately translates to dreams. Though the official languages of Botswana are both English and Setswana, there exists a large population of Batswana that either do not speak English or are drastically more comfortable in Setswana or another home language. This quality makes it logistically challenging to promote innovation practice amongst the country for two reasons. First, to ensure the national community is behind the concept of innovation, they must first understand what it is and why it matters. BIH representatives speak about running into this obstacle during conferences and road shows when trying to market the Hub as a place of opportunity for the country:

> "When you're talking about something that someone is doing, we have innovated, but also, you can go out and see something that somebody has done. We want to get a benchmarking of technology from others…A word that have more than one meaning depending on the context: If the word is connected to the person, it is bonokopila."
>
> BIH Employee

Fully explaining how innovation, in different forms, can be a *thing* one can benchmark, a product, a service, an experience, or a *process* these communities can engage in themselves, remains a difficulty:

> "The people who hear translation aren't aware of the type of effort and energy it takes just to do it. When someone is speaking, you need to make sure you not only hear his words, but you hear what he is trying to get across. When you translate you don't necessarily translate word for word what he says… [but you must] you really fully understand what we meant… you have to be creative with your words in order to imitate him."
>
> D'kar Steering Committee

Secondly, to practice innovation in its purest form, there must be cultural alignment with the topic itself. Practically, BIH representatives speak about how there exists the struggle to make innovation matter to the community; people ask, how can innovation help me in my life?

> "There's a famous phrase [in my culture]. It is 'Go siame,' or 'It'll be okay.'...It's basically saying that someone else will solve that problem…. People don't really understand what entrepreneurship is, so You have a bit of reluctancy. We have some people who don't use computers, some people who don't want stress…if it ain't broke, what are you guys changing, if I have my goats here, I'm making money, what do you mean now I need to start going online? What do you mean … [I'm good now]. So, you have that."
>
> BIH Employee

When I spoke about this concern to a UB professor who specializes in linguistics and lexicography, he mentioned how the cultural priorities of Botswana are an obstacle to facilitating innovative practice:

"The reason why the term so difficult to translate, is because a Motswana don't train to innovate, they train to preserve…. Look at initiation schools in our culture. They train men to be men, and women to be women [by passing down cultural knowledge]. They pass food, cooking, and clothes. In this, traditional is seen as authentic. If something is innovated it won't be as authentic, and thus won't be as valuable.'
"Look at farming patterns. Traditionally, we scatter seeds...The government introduced new farming patterns, and people didn't trust these methods until people saw results! Our way is not as commercial. [In our country] there is not pressure to make loads of profit… Innovation is related to corporation and profit…."

UB Professor

He also offered the hypothesis of linguistic relativity as a potential explanation. The hypothesis holds that the structure of human language influences how an individual conceptualizes their world. Using a cultural comparison, he mentioned how English has names for many types of dogs, but Setswana does not. However, there are many different words for the colors of cattle, but not in English. The culture develops words for topics, issues, and ideas they find appealing, and the 'traditional' framing has made the future-forward focus of innovation less aligned with valuable activity.

Another friction that hinders innovation, in the eyes of the innovation community, is the culture of dependency among its citizens. The years of unilateral economic development, and the rising and generational power of the government and international organizations have developed a community who have come to expect benefits to be available.

"The mindset change is key for us, because we are used to government giving us everything. We're not even saying just the youth, but even adults [expects this] which also negatively impacts innovation. Because if you are waiting for the government to do something then the opportunity for you to go out and do something yourself is very limited, we don't provide them with funding, but we don't let them use lack of funds as an excuse."

UB Professor

"There are three generations of people supported by the government. An example is the food basket program. What is the government supporting to make people lazy? They pay for school fees, they pay for the bill, they pay for you to eat. Innovation can never be properly understood in that reference."

Village Chief

"There has been a history of dependency of charitable organizations in Botswana, [you must] ensure that [you participants] won't promise a handout from the visit!"

IDDS Facilitator

Called a fifty-year-old dependency syndrome by an IDDS facilitator, this multidimensional support is perceived to produce people that have little reason, or interest, in making changes in their daily lives or the outside world.

For those practicing, or viewing others, who practice innovation, there are yet more cultural frictions. For the BITRI design team, it is critical to collect useful, accurate, and fast user testing data to ensure they develop products punctually. However, the customary village system requires that chiefs who run the villages allow all outsiders to conduct activities within their village's scope:

"Sometimes, we want a quick response... It's easier like that. There are so many issues involved [to collect data], first we must involve the chief, we have start some communication, then we have to wait for some response… sometimes it takes two weeks. So, we have to make it quick, quick, quick."

BITRI Design Team Member

Moreover, there is a struggle in the Botswana innovation culture to develop copycat innovations, which are systems or products that seem appealing abroad and that stakeholders suggest are the 'next new idea' in Botswana. In almost every example of this cultural artifact, innovation stakeholders gave the example of entrepreneurs suggesting bringing Uber to the country. However, the ride-sharing app in its current form does not work well in the country for a few reasons: people pay their taxis in cash, phone internet data is both sparse and expensive, and the internet mapping of the cities is inadequate for much of the country. However, the stakeholders were more concerned that the 'copycats' were more interested in hopping on the innovation bandwagon, instead of trying to address the tangible problems of the Botswana community. Though these cultural frictions exist, these innovation facilitators make it their goal to make innovation and entrepreneurship relevant.

"The Henry Ford quote works perfectly. 'If I ask people what they would have wanted they would have said faster horses,' is the exact same thing here." But people say it's just fine.
You really can't fight that. I can't force you to do something I can only tell you what's available for you to do. What you do want them to say, when their cousin has a project, you should go see the people at the Innovation Hub"
"I see opportunity in developing and changing my country. Most people, when they get that first taste of the outside world, they don't come back. I came back. The years I came back I saw an opportunity, I saw growth, and I want to be a part of it. [We cause ripples by spreading innovation, and] the ripple effect can cause mindset change."

BIH Employees

Further developing an innovation ecosystem will ensure more cultural tensions will arise. However, as mentioned before, building interest, passion, and outcomes of innovation must be aligned with the needs, identity, and thus the culture of Botswana communities. Developing tools and resources that better facilitate how and why innovation matters to the country will help bridge the existing gap between those who believe and practice and those who do not. For instance, one BIH entrepreneur uses Malepa, a traditional rope game like Cat's Cradle, to teach principles of innovation to children. By facilitating collaboration and asking the partner to better than the last person, it facilitates imagining the future, and putting that dream into practice. Further culturally responsive bridges like these will be very necessary for the cultural adaptation of innovation practice into Tswana culture.

Institutional Tensions

As has been the historical trend, the Botswana government institutions have the largest capability to establish national trends. With long-term initiatives like Vision 2036 and the National Development Plans, their design and implementation of the innovation institutions work to direct Botswana towards a new future. However, with this new institutionalization comes unexpected effects that limit the possibilities for beneficial innovation. One issue is a perceived fear of failure:

> "When you go in the government, you go up the ladder, and you get in a [cushy position], and eventually retire with a pension. The new leaders are chosen by the government. They try to convince the government what they're doing something. You cover your ass. For the person who sent you, you make sure it looks like you've done something right. Since they are from the government, they know they have to play the game. We don't have independent players from whom we can go to govern, everything comes from the government."
>
> BIH Entrepreneur

> "The desire to eradicate corruption – has created a climate of fear among senior decision makers. Everyone is afraid of being judged… people were in fear. Young men and women who have [been] studying, they are trying to see the country become the beacon of excellence that I see that they would be…. [Workers in their] fifties and sixties who have much difficulty taking too much institutional setup which is freezing the creative and inventive genes. The country could become the Switzerland of SADC. I am in favor of pre-imagination! Let the kids create."
>
> BIH Entrepreneur

Another feature of the innovation transition are tensions about the institutional systems that are involved in determining innovation in the country. Because the institutions that developed the innovation institutions are on the national level, the customary law systems, which govern at the village level and are a critical part of Tswana culture, are implicitly excluded from any processes that might align innovation with traditional legal institutions and culture. This then leads into a question about who decides, and thus who benefits, from innovation outcomes.

> "There is a dual legal system. Common law is not what [Botswana] started with when it comes to governance. It goes back to the colonial period, to how we lived before the colonial period, and the two are independent. Common law will take precedence where there is a clash…. You are asking what do they do professionally. but if you want to know how to do it customarily, you'll get a different view of it. People in these national entities, how they are compelled to do things by the common law and how they actually do things by the customary law might be different. Level of understanding might not even matter, done by the person in front of me that I cannot challenge. In parliament, this is the case, because a legislator, has power over...a policymaker who [better] understands a program. When they develop this legislation in parliament, [chiefs] don't have a say there."
>
> Chief, undisclosed village

"When you say Innovation, you are immediately thinking about big business. You're thinking about government. Those are the drivers of innovation, both conceptual and structural. They're looking for Innovation not just for the product, but for whom? And who really benefits from this innovation? If you can have me here in New Xade and have you help me find a way in which I can develop a process of my medicinal knowledge...I don't want to commercialize but to benefit from it. Because the San have a lot of knowledge in a lot of ways, from medicine, from hunting, from preserving things...Also if you look at other areas of society...I think, Innovation is defined from a position of dominance."

UB Professor

Silos of Innovation: Making Bridges, Breaking Walls

When innovation actors spoke about the issues that currently plague the evolving innovation ecosystem, they consistently discuss the topic of ensuring the resources are available to the whole innovation community. These resources come in the form of knowledge, skills, connections between organizations, and many others. These innovation communities hold historical knowledge, subject matter expertise, and access to tools that could help people research, connect, collaborate, and learn from failure, but the institutional barriers make them difficult to access by actors in other communities. I personally viewed this at the University of Botswana, where the Office of Research and Development, charged with advising hundreds of potential innovators about the ins and outs of intellectual property, learned recently about an intellectual property database:

"I got to learn that UB has access to a database about innovation, and how they can access them. And I was about ask, 'How can we access that?' and they told me, that UB was one of the subscribers to the database through the library! …. We are not using these workshops, and others don't know about it...We are the ones that are supposed to teach others how to use it."

UB Research Consultant

A wide variety of stakeholders were confused about where they should go to learn more about protecting their intellectual property. In D'kar, they reported being confused about who should commandeer intellectual property issues; whether the manager of the innovation center is the one responsible, and how to ensure they stay abreast of innovation issues, is still unclear.

Another issue is actively accessing research that might help innovators learn about cutting-edge research and technologies to support their commercial development. At the University of Botswana, a 2008 study of the attitudes of UB faculty members towards utilizing the institutional repository for their research; among the statistic, 73.6% of the sample were not even aware of the existence of the repository [133].

Another related issue is how a clear majority of the traditional knowledge outside of research is undocumented. Many of the stakeholders who would want to utilize, benefit, or protect the knowledge have little knowledge of its existence.

"...That's the problem of Africa – most of the stuff is undocumented. you can only learn if you go to the place, go to certain parts of Africa."

Seronga CCB Participant

Another critical concern is ensuring innovators have access not just to knowledge, but to people with the capacity to help each other innovate. Unfortunately, much of the expertise that could develop into advice, research, or commercial outcomes is in institutions that are difficult to reach for aspiring innovators; and social capacity is therefore stifled. University administrators mention how collaboration is critical to quality innovation, that they work to pressure their bosses to make space for it:

> "Middle managers know that the supervisors need to collaborate in the innovation space. [These supervisors] there managing the whole university, and don't know what to do in the entire space."
>
> Administrator, Botho University

Another concern is the disconnect not just between the resources and skills of different innovation actors, but their priorities as well.

> "There's a disconnect between what the shareholders want. They are saying, bring us innovative ideas. BIH says, focus on the [five National Priorities] you find that some of them aren't directly connected to those topics."
>
> External Innovation Consultant

Although there are stakeholders who believe that some of this 'siloing' of expertise is inadvertent, there are instances when it is not.

> "[The reason is] politics. UB sees BIH, sees BITRI, they don't want to be connected. There are a lot of gaps. The problem is, we tend to be operating in silos, we have the [Local entrepreneurship Authority], that has got incubators, but we cannot tap into those resources to facilitate for our students even during those courses, to tap into those resources, I've tried. I went to a guy who was Innovation program, and they said no no no, that is a non-starter…"
> "[The] goals aren't clear, and structures don't work together. A part of the reason is because there is a powerful collection of entities. Individual organizations might not work to address their own goals and might not work to synergize."
>
> UB Professor

Certain innovation actors said centralized policymakers have a large hand in developing the policies and culture that isolate these innovation organizations and stakeholders.

> "It dominates from Central...Why do we have BITRI there, not here? University is a space for knowledge...for creation of ideas. Those tensions are not just a question of actors, but of policy and structure…. The government says the focus of universities is teaching, and publications, and community engagement. If that's what they say, then what can the university do? The actors in agents in that institution will ascribe to that rule. If there's no funding for research, then they will say no, look for funding from outside! It sounds realistic, but innovation has a cost. You got to fund Innovative projects. So, for me we have to see the role of governments in this…"
>
> UB Professor

What needs to happen to ensure people are clear about the available resources? Many innovation facilitators mentioned the importance of clarifying the policies and resources that exist, but are invisible to the populous:

"[What is important is] policy clarity and the relationships between different actors... Between policy makers… [We need] policy promotion…When you go out, most of the stakeholders don't even know what is in there. How do you promote policies, how do you promote strategies?"

DRST Officer

"[We need] clarity for different institutions. People don't know what CIPA (and other institutions) do. CIPA should be the go-to for IP, BIH should be the go-to for commercialization.…"

CIPA Officer

In many ways, the dynamics of a healthy innovation system operate like a living network in which relationships are organically established, nurtured, and evolve into beneficial outcomes. Building spaces to develop those relationships, and having reasons to continue those relationships, is critical to change the mindset and culture of innovation in such a community. This is a required mindset of any entrepreneur; they must develop their relationships to make their innovations successful. Each of the entrepreneurs I interacted with was doing so: working to establish connections with clients, supply chain stakeholders, identify experts who can help consult on their projects, conduct research related to their pending projects, and many other topics of interest.

However, the way knowledge, people, and other resources are siloed off from other communities makes this connective process difficult. Though there are many opportunities and capabilities that will be built in the innovation community through the Hub, there is a possibility that many of the innovation actors outside of BIH see the flag-bearer of innovation in the country not as a place for innovation activity, but as another silo of a narrow type of innovation practice. Moreover, many existing innovation actors believe they have little reason to connect with each other. Some of the newer actors are actively building existing MOUs with other organizations to start to develop officialized relationships, and some informal relationships are beginning to develop. However, capacity in certain organizations is definitely 'locked,' and competition makes it difficult for communities to share their capacity. Moreover, in some organizations, such as in university settings where there is a cultural appearance of 'competition,' there are incentives to keep capacities and resources separate, instead of pooling opportunities to collaborate and synergize knowledge, skills, tools, funding, and people.

What is clear, however, is many of the innovation stakeholders see the many resources as out of their reach. In some instances, the data and insights made by Batswana are not collected or disseminated for stakeholders to benefit from; in others, stakeholders have not built relationships where communities can collectively collaborate on their expertise. Though this topic would benefit from further study, the collective capacity of the innovation community must be shared and catalyzed if it is to grow.

Innovation Protection against Western Exploitation

An important theme that arises from the development of this innovation ecosystem is to what extent the activities are driven by previous transgressions caused by international actors. As was expressed previously in the discussion on intellectual property, Botswana has experienced a history of global explicit and implicit exploitation by international actors who utilize intellectual property laws to protect resources they acquired from Botswana over the years. The story that represents this activity most vividly is of Sengaparile, or Devil's Claw, a plant that grows indigenously in Southern Africa. Used by the San for generations, the plant was everywhere in the natural environment and addressed a litany of health and well-being issues: from skin cancer, fever, malaria, and indigestion. Before expatriates found the plant, the San sustainably used the plant, as the knowledge of these plants and others were inextricably tied to the knowledge of their land, their cultural practice, and their self-identity. However, a German scientist found the plant and began the process towards commercialization:

> "A German scientist originally brought Devil's Claw from Namibia to Germany, and the plant was studied in 1950 at the University of Jena. Then in 1962 the company Harpago (Pyt) Ltd started to supply the German company Hagen Naturheilmittel with Devil's Claw. Now, the knowledge that once belonged to indigenous people is in the hand of foreign companies. The indigenous peoples do not earn much money from their knowledge; instead, it is the companies who earn the greater proportion of profits from Devil's Claw. As companies try to protect their intellectual property rights through trade secrets, brand names and patents, the control of Devil's Claw knowledge threatens to be taken from its original possessors with no recompense [211]."

The harvesting of the plant has grown an international market, and the indigenous harvesters without capital, technology, experience in cultivating crops, and land rights will be further exploited by international policies intended to protect endangered material. The growth of the market has only negatively impacted wild harvesters by increasing workloads with minimal increases on the already meager pay. Moreover, relatively recent advocates have asked that species of Devil's Claw be included on the Convention on International Trade in Endangered Species (CITES), which will drive buyers to prefer the commercial material. The indigenous harvesters without organizational collectives are the deepest in poverty and couldn't be viable competitors on the market, and restricting their only sure markets would put them in even worse situations than they are now. Moreover, the market on indigenous knowledge from Southern Africa has caused various outcomes that lie in direct contrast with San culture and livelihoods, including but not limited to denouncing equitable decision making and economic commodification of the plants over cultural independence [212].

This example of culturally influenced innovation is also occurring in more recent times. The kgotla, a public village meeting of a Botswana community, is a cultural artifact of Tswana culture that addresses all customary law issues. It serves a variety of purposes, from reaching consensus to solving problems, and as was explained previously, to acquire blessings from the community when expatriates are housed during an innovation summit. However, an organization inspired by the traditional system formed the idea into a Dutch startup in 2003 as a methodology of open dialogue to be spread all over the world. According to the startup, over seventy organizations in eleven countries, including KLM Airlines, Ernst & Young, and the Dutch Red Cross are clients of the organization [213].

This sentiment bleeds into research and development as well, where they are cautious about developing relationships where the outcomes of the research are unclear:

"A lot of the culture... is very skeptical, guarded, when it comes to people from the outside, especially from the US. they are a sponge for information. They only will share that which…. They don't lose power by sharing."

"People in Botswana…want to be the first one...and do not want to share the limelight. Because there is so few, they won't do it successfully… [To better innovation in Botswana, we need] to clarify to each other, to us… a family that doesn't fight grows together. Because we seem to not understand our concept."

UB BITRI Executive

It is in this context that innovation communities are not just working to develop changemakers, but to protect themselves from the systemic consequences of historical exploitation. Minerals, people, tools, and even ideas are pilfered from the country; in a context where many innovation actors are learning how to leverage innovation for themselves, it is important to note that some of the most innovative outcomes were developed and distilled for generations, only to be taken and eventually protected by international trademark legislation. Therefore, when measuring, designing, and implementing these institutions, this history must be made clear to ensure the innovation community can build upon this understanding in productive ways. Evaluation, as mentioned previously, is a critical role in this activity; building evaluative capacity by Batswana for Batswana enhances their ability to make data-driven cases for their ideas, their goals, and their ability to utilize their intellectual property as they see fit.

The Limits of Imagination of Innovation

Another theme that arose from interviews is the contested definition of innovation in this evolving ecosystem. To support the national needs of the country towards becoming an internationally recognized innovation powerhouse requires developing entrepreneurs that are focused on issues outside the country due the small Tswana market. This theme might also be driven by the context that many of the products and services -- many that are considered technologically superior -- come from expatriate companies.

"Going out of the [Botswana] market is a bonus. We are a very small population. The thing is, the challenges that societies face is very similar. The problems in Botswana are the same problems in Zimbabwe and Zambia and Sri Lanka… they are similar environments. If you want a good product, then you can always find it home."

BITRI Executive

"From what I understand about [BIH}, the people in that organization believe that innovation has to be at a higher level…. But they're not bringing innovation that would be suitable to our space."

CCB Seronga Participant

Innovation facilitators on the national level have developed national priorities of the innovation ecosystem that ensure stakeholder focus on the problems in the country; particularly, the National Priority areas: ICT, clean technology, biotechnology, mining, and indigenous knowledge systems. There are two related disadvantages to this policy; First, entrepreneurs outside of those national categories will fall between the cracks of governmental support. Secondly, innovation in the country will be directly related to issues that only focus on the National Priorities, but not on other issues. Though it makes sense to develop complementary focus areas that other facilitation institutions do not cover, such as LEA. However, by relating innovation to categories outside the reach of many Motswana, innovation institutions *run the risk of failing to address the problems of everyday citizens*, and the solutions these citizens could bring.

"If I am a Motswana, I should just be limited to the area that they want to cover, they should also have the capacity with assist the development of the technologies…. The same applies to BIH. BIH is only limited to four sectors. So, any innovators fall within the cracks."

UB Entrepreneurship Professor

"BIH is focused on science and technology…. when you go to people and use the words innovation or technology…. [Citizens say] you guys are focusing on ICT only, so they feel like this is not for me. So, you try to combine the two, right, because Innovation is not just limited to four sectors…."

BIH Employee

There are also concerns about ensuring that Botswana develops a form of innovation that is not hindered by cultural trends present in the rest of the world.

"The focus of BIH, they're trying to be like the innovation like Silicon Valley, but we can find a different type of innovation that can be inspired by us."
"I come to your country, and I see people with iPhones, and they stand in line and spend $1,000 for the next iPhone! And I go up to them, and I say I'm from Africa. Can you give it to me? And they say no, it is mine, and it gets to the concept of wasteful innovation…"
"We also have to think about where we are what we are doing how we're doing it and how we interface with the global world."

UB Entrepreneurship Professor

It is clear as well that the government, as with many institutions in Botswana, has extensive power in guiding and supporting innovation activity. However, a case is made by some innovation actors that the institutions that support innovation also potentially hinder innovation outcomes.

"What makes it uniquely Botswana is, the government is everything. How do you look outside the government?"

External consultant

"The best way to [enable innovators is] allowing the innovators to drive the innovation, as opposed to officers. It's nice to have master's and doctorates, but they don't lead innovation. It's led by someone who goes out to do something. BIH has to stand intimate with their innovators."

"We have bigger issues than telling us get financial records every month. Some things are nice to have, but they are not essential if you tell us to make financial statements every month. If you tell us You need money, and you need to bring in money! The indicators for success need to be co-created, people with these traditional definitions of success have what they need to succeed, and they don't work on the ground."

"You bring an officer into a landscape, they won't think like an innovator. These institutions should be open to a company to run it. Let's give it to a successful entrepreneur. If that guy started from the bottom, he will understand intimately in the local landscape? What will be done to push innovation forward?"

BIH Entrepreneur

These quotes and observations represent a collective definition of *innovation imagination*, which represent how topics, issues and outcomes of innovation are practically envisioned by the flagship innovation institutions. Though it is important to set a vision that is useful and beneficial towards moving the country forward, we must not forget that innovation activity requires us to develop a world unexpected by those who facilitate it, and to thus put trust in the hands of those actively making that world. By broadening this imagination and the types of problems that innovators feel welcome to address, the institutions expand their ability to support entrepreneurs -- towards everyone's benefit.

So, one might ask, how can we bridge the gap between the types of innovation that are considered valuable? An article in the BIH Innogram mentions a similar issue when discussing how employment issues in the country should be addressed, and suggests the following:

"There are two options: Bring the imagined futures of the students closer to the ideal of policymakers by, for example, convincing that there are opportunities in agriculture, and that life in the city is not always rosy.

Policy makers and development professionals should reimagine the future – and specifically the nature of the economy and society, and the role of the State vis-a-vis the young people. Imagining would provide an opportunity, and to allow the Imagine future embedded in policy to move closer to and align with futures that students imagine for themselves [119]."

I offer an alternative, which aims to honor and support the expertise of fledgling Botswana innovators to broaden the future. First, policymakers should make space -- financially, institutionally, and otherwise -- to support innovation practice **outside of the national directives**. Secondly, there must be further opportunities for **empathetic and responsive policymaking** directed towards the needs of these fledgling entrepreneurs. Ensuring these stakeholders become 'intimate' requires a deep understanding of the innovators' context, their struggles, and their resources, while they try to develop new markets and solutions to complex problems. The facilitators, thus, should work to become the least of these entrepreneurs' worries. Thirdly, there **must be built-in flexibility** for the innovators and the institutions that support them to fail, learn and adapt. Learning about what resources, guidelines, connections, and initiatives work through these rebuilt relationships, and those that do not, is a critical activity.

Facilitating Inclusive Innovation

Another insight relates to who can contribute to the broader 'innovation imagination.' Such an imagination is as developed as a populous' personal capacity to view solutions, generate ideas, and make those ideas a reality. Critical to catalyzing a broader and more concrete innovation imagination is the development of a population that can engage in research and development and can also connect with stakeholders around the country to help realize outcomes for Botswana, by Batswana. This brings up the question: are Batswana included in this national transition? The context shows that in its national form, those who can innovate must first have an exceptional amount of educational, financial, locational, and professional privilege before they can be a part of the innovation community, and systems must be developed to ensure other entrepreneurs can be feasibly included.

Fortunately, this research topic has precedence. Gastrow, Kruss, Bolaane, and Esemu investigate how universities can facilitate what they call innovation and inclusive development of ecologically fragile communities. They use the term 'borderline innovation' to describe activities that occupy the boundary of innovation: highly localized, low-technology, informal, and minor incremental changes of a mostly social or organizational nature [214]. The researchers investigate multiple case studies, including the Kuang Hoo Community Trust, another San organization in Botswana. The document mentions the importance of universities acting as facilitators in activities that wouldn't be considered globally innovative but are widely beneficial to the marginalized populations.

> "To achieve their potential, universities must overcome the constraints of existing knowledge and power relations, be more responsive to social concerns, and grow institutional commitment to development objectives. The informal economic activity that underpins the livelihoods of marginalized communities largely remains isolated from the knowledge flows and innovation opportunities that emerge from universities. This raises the question of **how universities extend their knowledge-generation roles to the benefit of the informal livelihoods of marginalized communities** in a participatory manner….
> In all three cases, the nature of the innovation involved in the interactions occurs on the boundary of the commonly accepted conception of innovation…. The innovations that took place were not new to the world, to the country, or to any particular sector. They were new only to the particular communities in which the interaction took place. Moreover, none of the innovations were knowledge intensive or technologically intensive – it seems that the very limited absorptive capacities of the communities prevented such innovations from being considered, let alone implemented. However, this does not imply that the innovation has not made a substantial contribution towards addressing livelihoods problems. On the contrary – **the social innovations have played a key role in enabling each community**, to a greater or lesser extent, to practice sustainable livelihoods and defend their livelihoods from external threats. It is conceivable that without these 'innovations' the communities could have lost access to their livelihoods and thus increasingly vulnerable [214]."

Although the main facilitation actor in this dissertation is not a university, the lessons from the study still resonate with my findings from the field. Multiple stakeholders mentioned how the innovation flagships are implicitly exclusive of many Batswana:

> "...Only the people who have the privilege to get into BIH, for classic development, it's educated folk... [who have] gone to school I've had my diploma, and then are developing businesses. It should be all inclusive."
>
> External Consultant

"What is the key vision? Is it a vision that is embracing everyone, to say that I am a part of this vision?"

UB Professor

"Our government lack that push to expose our people, to be a part of the group that invents."

Chief, undisclosed village

An unintended consequence of aligning innovation with the construction of a single high-technology innovation park is how it leaves a gap between those who can access it and those who cannot. This does not just mean those who are aligned to the National Priorities of the Hub, but also those who live in the capital city and those who have enough education and expertise to contribute to those fields of interest.

"They are just building up the numbers, you need to be critical enough to see whether this is a critical innovation, they want to bring up as many people with incubators, as many as people Remember, BIH is not just looking at innovators, but the innovators of those 5 categories."

External consultant

"I'm coming from a background where it needs to be first before we talk about innovation, we talked about whether people can be carried onboard as participators for the legislators and the policymakers, how to define innovation. And how Innovation should be carried. So, to some extent, if you go out to the Villages, quite a lot of people will ask Innovation what is innovation in the first place because they want to have a clear understanding what Innovation is, and sometimes, if people know, they don't see it being practiced."

Chief, undisclosed village

On the other hand, the Botswana IDIN community is a case study of an institution working to expand the definition of an innovator, and what types of problems are worthy of being solved with innovation activities. Extensive resources have been harnessed to make innovation of useful technologies a possible activity for this community. However, obstacles still exist that keep this community from being sufficiently empowered as they would like.

"[I] asked for some advice from some of the [experts]. It is difficult, because people have to come here, and when they left, it is difficult for me to learn about my project, because I am stuck behind. Feeling like I have to wait…. Technical know how is lacking for other projects."
"The ecosystem stops when people leave."
"The projects are not progressing. Students come, they should buy the materials, because they come, sometime they use up the tools, and then leave."

D'kar Steering Committee member

"The problem is we are not going to obtain any material….no-one will provide us with the material for something like that. We will stay with that education, but it will be forgot."
"[My biggest concern with the design of these technologies?] The cost of materials. Prohibitively expensive, have to ship it from the big town from a far away, it's prohibitively expensive."
This was the case for the tools as well: without resources to develop the projects, or to practice the skills they learned at CCB projects, they will eventually be lost over time.
Seronga CCB Participant

(Will the farmers have access to these tools?)
"Maybe not in these kinds of workshops, but maybe in this village, where farmers can work inside their fields. Transport issue is one thing, but cost is the other. So, they wouldn't otherwise have the means to work on something like this."

Ecoexist Executive

"They are lucky in the way that they have an innovation center, which creates an opportunity to create a living out of their innovations. But at the moment it remains a dream they cannot reach… because they do not have means for creating a living for themselves. So, then they end up shutting the innovation center down…"

IDDS Steering Committee Member

Developing an innovation hub requires a wide variety of easily accessible resources, from tools, resources, knowledge, and subject matter expertise, to the connections to facilitate development, and the free time to work on the innovation. Though D'kar has performed admirably by developing the country's first makerspace, **its geographic and institutional disconnections make it nigh impossible to develop their innovations independently.** The geographical and institutional distance of the community makes it difficult to have sustained, influential change in many of their current innovations, leading to the fear that after all the investment over the years whether:

"...as soon as we leave, these guys are gonna go back to [what they did before]."

Seronga CCB Participant.

So, what can be done to ensure the innovation community further includes the needs and values of the communities they are serving? To start, we must learn from them how they approach innovation, and acknowledge the rarely acknowledged expertise of these communities.

"The San people… survive on very challenging geographical conditions in the earth. That, on its own is its own version of innovation, that has been playing a role in keeping us alive…"
"It's probably difficult to talk about in isolation innovation because the way I think about innovation, is that it is intrinsically woven into a person's way of life."

D'kar Steering Committee Members

Two lessons resonate here. The first is how innovation practice must be used primarily as a problem solver; as one who aims to understand issues in life and works towards addressing them. Secondly, the committee member sees innovation not as a separate act, but as a quality of everyday life. Learning to communicate how the innovations are baked into people's lives, and how they can be harnessed for broader or deeper benefit, is a critical lesson for any aspiring innovator, or any innovation facilitator looking to build an innovation culture.

Another important community that stakeholders discussed as essential to include is the future leaders of the country -- its children. It is important to develop these institutions for the innovators of today. But, what of the children that will grow and take those entrepreneurs' places? To ensure the country breeds a generation of innovators, one must consider the institutions that facilitate innovation practice on their level -- the educational systems.

"…there might be a ten-to-fourteen-year-old, very bright, very innovative, and might have never been exposed to this type of this environment. That's why it needs to come from the grassroots. It should be attached to all aspects: the kids, and the community…"

External Consultant

I found this insight compelling for two reasons. Of all the innovation actors and institutions to be built, few discussed the role of primary and secondary education in facilitating innovation pedagogy. The closest institutional mandate is the Human Development Resource Center that isolates tertiary and lifelong learning-based policies that support developing an innovation-minded populous. However, building a sustained and generational innovation community requires teaching innovation at all levels of education. There exist a wide variety of educational resources that facilitate innovation education, at the classroom [87], school, and national levels [215]. I leave this issue to future researchers to develop in-depth research and implementation plans.

Co-design based innovation *moves at the speed of trust*, ensuring communities build up the capacity, relationships, collective knowledge, and outcomes necessary to determine beneficial activity. In many ways, innovation in this form is grassroots-led, facilitated by person-to-person relationships between individuals who view outside their personal imaginations, see opportunities for mutual collaboration, and steadily develop outcomes that can eventually build a new reality. In this, much can be learned from communities who work to develop holistic resources towards beneficial innovation, such as the International Development Innovation Network.

Another barrier to the ability to sustain innovation is ensuring the included stakeholders have the capacity to move forward with their innovations as they see fit. The more intellectual, social, technological, and institutional resources that are accessible to every Batswana, the faster the community works towards beneficial innovation outcomes. If the foundation of innovative practice is the floor in the innovation house, the capacity and people's access to it is the ceiling. I leave it to the Motswana policymaker, and others who aim to learn from this experience, to determine how high the ceiling can be built.

Hazards of Development Innovation Practice

This dissertation has already analyzed how participatory innovation practice is a sophisticated yet necessary approach to ensure the goals, expertise, and humanity of the targeted community are included. This does not mean that the activities are foolproof solutions to addressing poverty issues, however; in fact, hazards of many kinds abound. This study would be remiss without noting how poverty-focused innovation practice was revealed to be precarious during the research, and how innovators must consider these realities if they resolve to engage in beneficial practice. One of the most essential elements of innovation are the resources necessary to engage in the practice. Facilitators and participants of IDDS talked about how those resources, such as tools, activities, materials, and even time are required to research, create and test innovations. However, the local communities involved are often looking for interventions with ensured immediate outcomes, which make their lives marginally better. This tension might make it difficult to find alignments: though the marginalized exist day by day, the privileged interventionists aim for the stars, and both communities fail to see each other's visions.

"Those from the outside, they have the ability to design, because they have the capacity to wait for the design process to take effect. Design is a very long process...Who have food on the table, who have money…Focus on a project where they can generate income."

IDDS Facilitator

Another concern is the problems related to overly standardizing innovation practice methodologies that fail to fully acknowledge the context of the communities. This occurred during the CCB workshop in Seronga, where one of the activities was to teach the participants how to create charcoal. In Seronga, where wood is not scarce, the activity could have been replaced by many others.

"We must try to address [and inform] the context. If you teach people how to make charcoal, that's fine. But, in that context, is it really important? It's not. Environmental issues… they are understood here. We might have to look at the context and develop design solutions based on that."

IDDS Facilitator

There were also concerns about raising unrealistic expectations because of communication issues. As was made evident by the end of each workshop, extensive research and development would need to be completed by villages, researchers or other stakeholders, to ensure the products could be useful. In this, some facilitators expressed concern that there was an overemphasis on the tangible products to come out of the workshops:

"...It has to be clear. If you're talking about poverty, unless you are saying we're here to develop skills…Stop raising unnecessary expectations! [A participant asked me] after the trip, they were going to be paid? [She said] She was supposed to go for a trip [and went to this instead.]

IDDS Facilitator

In development-centric co-workshops, the local community has much more to lose than the expatriate innovators. The locals are continually engaging in a personal calculus about whether these activities are even worth the hassle. What makes this different when considering innovation practice is that the outcomes, and sometimes even the activities, are unclear, evolving, and emergent, which makes it even more challenging to make the case that they should be included. When struggling to make ends meet, how appealing is developing a relationship with a community where the outcomes are unclear? To address these issues, IDDS Botswana has developed various assured outcomes to these activities, of economic, environmental, policy, social, and technological means. However, when working in innovation-centered development, one must always consider how precarious the experience is for some of the population.

Another point of concern is about the invisible power dynamics that are enforced by these activities. The IDDS team has done extensive work to ensure that everyone who comes out of these workshops leaves with more than when they came in. However, looking at these workshops through a lens of power reveals how benefits of the workshop are differentially experienced by different stakeholders. As the sole relationship builder between D'kar and the rest of the innovation community, both as a stakeholder over the international Steering Committee and as a highly advertised ethical entrepreneur inside BIH, Mashaba holds extensive power over the direction, vision, goals, and resources of the D'kar stakeholder community. He came to D'kar with education, resources, funding, an extensive and growing network of entrepreneurs and affiliated

specialists, and a connection to the outside world that can help advantage the D'kar community members. As a gatekeeper of sorts, any person in sole power such as this has the most to contribute and inversely, the most power to take away. This creates an incentive to ensure that the community stays in good graces with such a powerful individual, which is a hazardous and limiting state to be in.

Similarly, the global IDIN community profits from the extensive ecosystem that was founded and built at MIT's D-Lab. Though MIT breeds designers in many various contexts, in doing so the program has bred an axiological and methodological foundation, a vision, and a plan for action to carrying out said vision of participatory co-design. In this, the programs facilitated at MIT have afforded the community an appreciable amount of intellectual power over how development practice should be implemented; for example, the theory and practice of 'design with' and 'design by' innovation, and the CCB method. Although I used this framework copiously in this dissertation, it is also useful to investigate the assumptions behind this model, and the unintended outcomes of the work developed by IDDS and other related organizations.

By stating a design is 'with' the end community, or 'by' the end community, the method requires the designers to make assumptions about who the 'local community' is. This topic is already contentious in fields like development, anthropology, and geography. In IDDS and other similarly constructed methods, the communities who are involved find themselves in one of two categories: outside the community, or inside the community, and the assumptions behind these statements are rarely interrogated. Each community is invited to IDDS because of the expertise and capacity they bring to the space: those on the 'outside' might have experience in a useful discipline, be it wheelchair engineering and service provision, business modeling, research and design thinking, to name a few. Those considered as 'inside' the communities are considered the 'locals' and are included in the innovation workshop because of an expertise rarely valued in other development spaces, but directly tied to the design context: translation, understanding of the political and cultural dynamics of the space, ability to translate, cultural knowledge, and the like. In IDDS, the facilitators work to develop space for these types of capacities and many others, to ensure the development of useful, culturally appropriate, effective technologies. At points during the workshop, those demarcations were made visible to the populous: those from D'kar were locals, those from Botswana were a bit further away, those from other African countries were further yet, and everyone else who came from international spaces were even further.

One insight from this demarcation is how the participatory levels -- 'Design For', 'Design With', and 'Design By'--represent relationships to facilitate good design among these communities. It's not just that the end user is needed, but those from the 'outside' are needed as well, as is the relationship built at IDDS to engage in good design. Another insight that follows, however, is how people differentially benefit once they leave the workshop. For instance, those 'outside designers' who were a part of IDDS because of their expertise can benefit from their capacity to remain mobile. As they came from all over the world, their skills and knowledge were enough to get them to D'kar. At the same time, what they developed at D'kar *can then be used to remain mobile*, can build experience moving from development project to development project or innovation to innovation. They then gain the ability to learn even more design skills and contextual knowledges to increase their 'expertise,' which makes them more valuable to conduct design work. This is exactly what I experienced; as a part of the development system, talking about my experience exposed opportunities to continue similar research simply by having attended the workshop in the

first place. These outcomes seem understandable and valid, except when compared to what local communities gain out of the relationship. The local communities' outcomes bind them to their contexts. They might gain a 'life-changing' experience, better self-efficacy, increased creative confidence, or new technologies, but the 'local' developers are bound to the further development and outcomes of the technologies -- whether they want to or not, for better or for worse. Though this can be considered a good thing, as with a community who is tied to their land as fiercely as the San, what makes this outcome unique is that they *don't have the choice to be mobile like the outside designers do*.

This happens because IDDS is not divorced from the system of international development. It, like all other international designers, grapples with consequences of the remote design problem. As a field that prides itself on international expertise, global poverty incentivizes the professional development of the 'outside designers' without giving the 'local' communities the opportunity to contribute. This reality is an aspect of the development calculus each designer must personally grapple with; participatory communities are not just a bundle of local experience commodified into design outputs, and their lives might very well become changed in unintended ways by the fact that they are a part of this innovation community, for better or worse. Keeping these power dynamics in mind is critical when aiming to develop solutions that aren't just repeats of the decades of work conducted in D'kar.

This analysis, however, is in no way intended to assume that the centers of power in this space, be it an IDDS Stakeholder Committee, or MIT itself, are unique in this practice. Most development projects must navigate dynamics between powerful institutions such as universities and funding agencies, and the less powerful, like local villages and community-based organizations. Power dynamics between the disempowered and the more empowered must always be navigated. Acknowledging this reality, however, can open possibilities to *innovate how power can be shared*, instead of commandeered, to benefit development issues. A few opportunities informed by the research come to mind:

- to develop programs and systems to support ideas, by Batswana, for Batswana,
- to ensure the 'outside designers' reflect upon their privilege and ideate opportunities to personally empower the communities they work with, and
- move in the long term towards a time when single intermediaries to remain independently sustainable are no longer required, and
- to ensure local values lead the design practice.

Mathambo, an IDDS facilitator, has drafted a paper on this very issue, which can be a great foundation towards facilitating San-dependent innovation practice and methods.

> "Kuru has learnt a lot in his more than 16 years of experience and development circles. The first thing that could learn was that there does not exist a particular unique approach to development.... In the San context, some of those principles are: respect for the land, consensus-based decision making, generosity, sharing and reciprocal use of the different resources in land, indigenous knowledge and information, gender and equity, and mutual respect for people's ideas values and ideology [216]."

A Critique on Innovation as the 'Development Solution'

Through further introspection is always needed on how innovation is approached, facilitated, and supported at the national and local scopes, what is clear from this study is how innovation is reflected as a project of international development. Though economic historians trace the influences further back, since right after World War II westernized countries have developed international institutions, such as the ancestor of the World Bank and International Monetary Fund that aimed, in name, to provide economic, institutional, and cultural benefits to the world's countries. These activities, and a litany of others, developed institutions that established international movements towards "developing" countries' economies, governments, health, education, and overall cultures. These movements had various names, including Import-Substitution Industrialization, Basic Needs, and Structural Adjustment, and each movement held at its core a theory of change that suggested the resources, policies, and activities a country needs to engage it to 'become developed.' Development takes multitudinous forms throughout history, from economic self-sufficiency, to further integrating populations into the world market, engaging in democratic governance, addressing human rights, and improving the standard of living of residents, to increasing freedoms of the marginalized communities. Like much of the African Continent and the rest of the world, innovation is becoming another institution that is intended to 'develop' the country. This is shown by how innovation is perceived, how policymakers cement it in policy, and how they evaluate innovation, and through the very spread of innovation practice as a silver-bullet to development concerns.

On the international level, numerous examples reflect this quality. For instance, the Global Competitiveness Index directly categorizes countries into levels of development to determine how the indicators will be weighted. Though this requires countries to obtain more weight on the categories that align to their economic profiles, this pressures countries to develop institutions that help a specific country move up the ladder of development. The insights from these indices are taken seriously by Botswana national actors to help guide their institutional visions. In the organizations, the influence of international communities that hold as the standard of innovation activities is evident. BIH is modeled off innovation clusters in many other countries and implicitly influenced by Silicon Valley. BITRI is affected by policies that benchmarked high-technology research centers and economic clusters worldwide and aims to be a global competitor in their fields of interest. Their collective mandate to sustain economic development, decrease unemployment, and diversify the economy, all through the national transition to develop a knowledge-based society, reflect an aspiration to develop as other countries have. On the community level, participatory innovation practice -- in the form IDIN presents it -- builds upon the foundation of previous poverty-based praxis and develops new methodologies for empowering poverty that navigate the history of development activity in D'kar, and promises improved self/empowerment, skill building, and socioeconomic gains with its interventions.

However, it is important to state how innovation institutionalization and practice is different in the Botswana context. The field, more than others that came before it, aims to develop institutions that catalyze local capacity to create new technologies instead of adapting old ones. Developing the corresponding policy institutions that facilitates a breeding ground for many capable innovators, instead of developing linear, predictable theories of action for beneficial development, is an important priority. Moreover, another difference between this and historic development projects is how there is yet no clear tie between multilateral institutions and national policies. Though there

are obvious connections made between western actors, such as Sweden, Norway, and the United States, these shifts in policy are not directly tied to development aid like previous development projects.

However, the innovation community must not fall into development traps by not learning from history. There are many development issues that exist, related to health, human rights, and democratic rights, that cannot solely be addressed with only commercially-directed innovation activities and outcomes. Vermeylen's case study offers a significant example of lessons learned by investigating IP rights of the San in Southern Africa, and how an internationally commercialized development backfires on addressing the economic and cultural needs of the indigenous community.

> "Using a property institution, like intellectual property rights, that is known for its inequality, as the basis for economic bargaining might not be a good idea when the main objective is readdressing power relations and inequality….
> As long as the San are not perceived as equal citizens in local and national and international contexts, using intellectual property rights as a tool to readdress injustice and equality is doomed to fail. If trading cultural property is seen as a political act in the sense that it is used as a protection tool to conserve traditional knowledge it might make sense to link the intellectual property rights framework to a human rights debate [212]."

Moreover, care must be taken that innovation supports the marginalized, instead of harming their ability to express their culture when integrating into the global community. By believing the theory that all communities should benefit from innovations, some institutions assume that marginalized communities should also play by the rules of Western innovation institutions. An example of how institutionalizing innovation can hinder the identity of San communities is available in Vermeylen's reflections on benefit sharing agreements of Hoodia:

> "The CBD (The Convention on Biological Diversity… demands equitable benefit-sharing from the use of biodiversity, forcing companies who have patented medicines based on indigenous knowledge to accept the idea that those indigenous peoples must somehow be compensated. While such distributive agreements are clearly a great improvement on the previous practices of outright theft, there are still questions to be raised about the moral validity and the actual social consequences of these particular approaches to the commercialization of indigenous knowledge. When we look at the situation in the field, in both Namibia and South Africa, a schism can be identified between 'ordinary' community members and 'elite' community members. In their struggle for the recognition of their basic human rights, the San were pressured by NGOs, donors and governments to organize themselves and appoint leaders. Increasingly, it is expected that the San speak with one voice.
> The CBD must be questioned for its belief that private property rights drive the most efficient and sustainable use of biological resources. It champions commercialization and privatization of intellectual and biogenetic commons whilst simultaneously allowing some benefit-sharing provisions for the indigenous peoples in the hope that this will allow indigenous peoples either to maintain control over their knowledge or at the very least to benefit from the commercialization of this knowledge (Martin & Vermeylen, 2005). This case study thus highlights the intrinsically problematic nature of the CBD as a construct that on the one hand accepts a 'Western' notion of exclusive ownership of knowledge and on the other hand seeks to offer justice to indigenous groups whose values and traditions are very different and (consequently) whose position in society is very weak [217]."

One size fits all solutions rarely work for all contexts, and innovation actors must take care in moving forward that innovation institutions do not further impoverish people at the margins. As stated before, ensuring every Motswana aiming to innovate can self-actualize their imaginations remains a priority.

Future Directions for Research

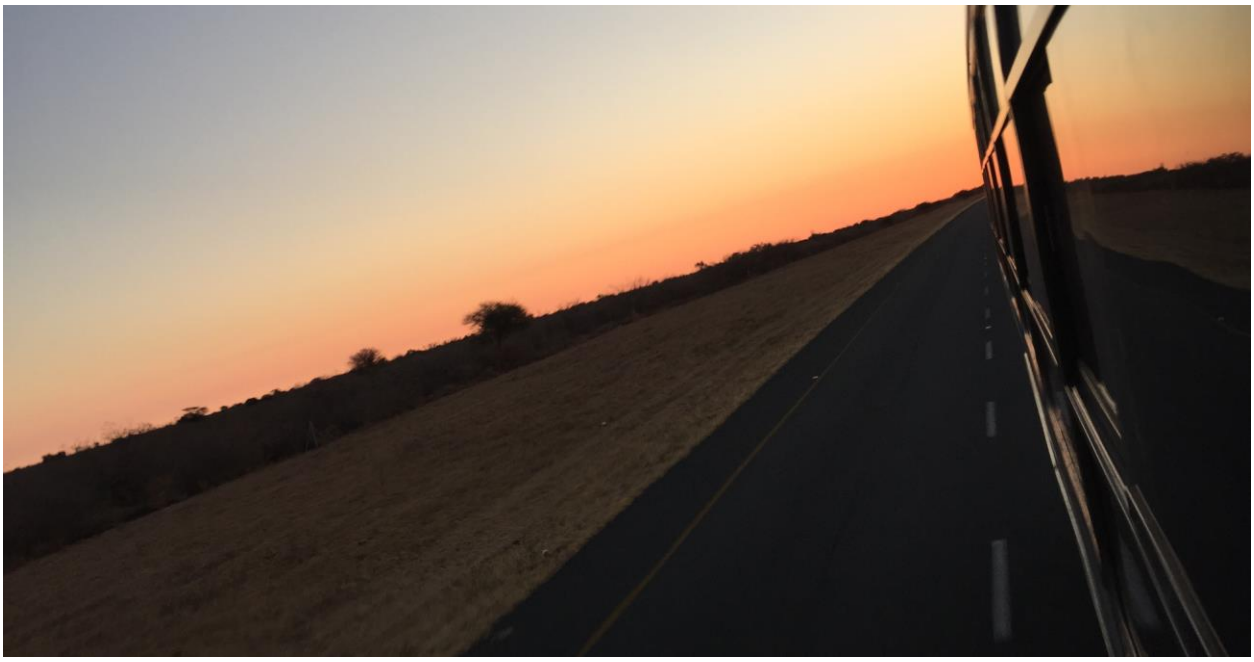


Figure 38: Leaving IDDS 2016.

The narrative here aimed to interweave multiple unique stories of transition: to further contextualize the purposes of innovation activities, while interweaving themes of empowerment, inclusion, innovation, intellectual protection, and evaluation approaches. This story also investigates two prominent innovation visions: nationally-directed innovation, and community-led design practice. As this work concludes, I asked myself: where can this research lead? To extend the insights, utility, and cultural alignment of this research, I suggest these critical future directions.

Increasing Evaluation Capacity in Botswana Institutions

As was shown in this research, evaluation methods serve a wide variety of the purposes of these innovation stakeholders. As was expressed in depth, though many of these goals are aligned with each other, there are some gaps this research revealed. How is innovation at the margins valued? How do the national organizations determine the social impact of innovation in the country? How do they evaluate innovation that doesn't come from technologies? How can innovation outcomes in complex, dynamic environments be recognized and systematically addressed? Fortunately, there are evaluation approaches that support each of these needs.

One mandate on innovation organizations is to prioritize and broaden innovation practice in the country -- and thus, to broaden the capacity of innovators. Both IDIN and BIH have noted a critical part of their mandate is to build capacity for their entrepreneurs to be able to independently design their technologies. Fortunately, two evaluation fields are created to assist in inclusive innovation. One example is Empowerment Evaluation, developed by David Fetterman, an approach that provides communities who are most influenced by the development interventions with the tools and knowledge to monitor and evaluate their own performance. The foundational text outlines theory, principles, tools, and methods to facilitate end users' ability to engage in the self-

determination of their activities' value [218]. Another related and useful field, called mainstreaming evaluation, aims to shift the culture of evaluation and organizations to ensure evaluative thinking is commonplace. "Mainstreaming refers to the process of making evaluation an integral part of an organization's everyday operations. Instead of being put aside in the margins of work, evaluation becomes a routine part of the organization's work ethic if it is mainstreamed. It is part of the culture and job responsibilities at all levels of the organization [219]." Though there has been research and practice that aims to institutionalize these methods into existing organizations worldwide, it has yet to be conducted in development-focused innovation practice. These fields offer useful methodological foundations in determining ways that the evaluation approaches are spread to innovation actors and throughout innovation organizations.

There is also a pressing need to ensure that innovation actors can understand the dynamic and evolving contexts in which innovation is situated, so the appropriate evaluation approaches can be applied. The diverse actors have overlapping goals, communities, and activities that are evolving in the current context. Fortunately, there are two evaluation approaches that are useful in these types of situations. The first, Developmental Evaluation, is an approach that assists social innovators to develop social change initiatives in complex or uncertain environments by facilitating real-time feedback towards the continuous redevelopment of interventions by responding to changing contexts [89]. Another approach, Outcome Mapping, is a methodology for planning and assessing development programming oriented towards change and social transformation, by providing a set of tools to design and gather information on the outcomes, defined as behavioral changes, of the change process [220]. Learning how to adapt evaluation strategies to the aforementioned innovation institutions, which struggle with valuing the multi-stakeholder, evolutionary nature of innovation communities, yet remains a gap towards systemic integration of the fields' insights.

There is a plethora of other evaluation fields that might assist the evaluation capacity of innovation actors that draw on various worldviews and analysis methods and determining the tools to use can cause decision paralysis. To ensure the innovation communities have access to these resources, it is also essential to build a relationship with evaluation networks, such as the African Evaluation Association. The organization was developed to respond to a "growing demand for information sharing, advocacy, and advanced evaluation capacity building in Africa [221]." Communities with this expertise can help direct understanding of the needs and capacities of this ecosystem.

Systems Mapping of Innovation Ecosystem

As was expressed, one critical concern of the ecosystem-focused study is that the entire ecosystem was not captured in its full form. Though much can be gleaned from learning about how specific actors are aligned and historically framed to engage in innovation practice, many insights can come from learning how the full scope actors interact with each other.

As has been expressed multiple times, the Botswana innovation community is in transition. As such, much of their work is the development and evolution of an existing ecosystem with a wide variety of actors, purposes, activities, and relationships. Understanding how these actors interact, what barriers exist, and what opportunities can then be leveraged to develop a healthy innovation ecosystem is a helpful research endeavor. These qualities are evident in the system:

- *Emergent* – The ecosystem is unknown from the beginning; they learn as they facilitate and practice.
- *Complex* – Many different interweaving actors and influences impact the state of the system.
- *Nonlinear* – A proportional input might not equal a proportional outcome in all environments, akin to the ripple effect metaphor.
- *Uncertain* – The outcomes to certain activities are undetermined.
- *Dynamic* – The ecosystem changes over time.

In this type of environment, though there is institutional focus and history in developing one-stop shops that support a particular government activity, it is nigh impossible to understand one actor of this system (BIH, for instance) without understanding how they connect -- and should connect -- to the many actors: BITRI, CEDA, LEA, HRDC, CIPA, UB, BITC, and many others. Systems mapping is a useful tool that innovation actors can apply to such an issue. These methods, alongside innovation practice, help to map systems of actors and how they interact to learn about opportunities for revealing unseen contexts, finding points of leverage, and addressing system-wide complex issues, such as catalyzing a national transition towards a knowledge-based economy. Previous studies have been completed before on this very issue. An in-depth analysis of the actors, roles, and opportunities for adapting the innovation ecosystem was developed to support education reform to model Newfoundland and Labrador's education system [215]. Kumu, an open-source resource to build system maps, is a useful open-source resource that can be used to develop, analyze, and share systems maps and their outcomes [222].

Uniqueness, Capacity, and Needs of Botswana and African Innovation

Much of the work institutionalizing innovation in Botswana was developed through benchmarking: for instance, by learning about the policies that worked in SADC countries and abroad, and by learning from the metrics from the Global Competitiveness Report and the Global Innovation Index. However, opportunities exist to outline what makes innovation unique in the country, and on the continent as well. Though growing and connected, this project only reveals a purposive snowball, ethnographic sample of the innovation practices in Botswana by including a few of the communities related to innovation. Each actor working to address problems in Tswana society, institutions, and culture with new solutions could be analyzed in the same manner. There are abundant opportunities for developing understandings of the unique qualities, capabilities, and obstacles of innovation practice in Botswana and abroad from the development of further case studies on the continent. Also, what would be useful is the development of inference and causal studies that aim to that aim to synthesize evidence of the impact and benefits of innovation activities in the country. The country is rife with opportunities to expand on the insights in how they practice, facilitate, or study innovation. I include a few examples below.

- Learning about obstacles to spread innovation practice to different villages and provinces,
- Documenting the innovation chain of single interventions while trying to reach commercial independence.
- Documenting and analyzing local innovation opportunities,
- Analyzing the human capacity in the country towards innovation across organizations and stakeholders, and
- Leveraging innovation spaces towards the development of the community.

Broadening Innovation: The What, Who, Where, and Why

There is a rich literature in understanding practical lessons in conducting socially-minded innovation practice throughout history. A few canon examples include E.F. Schumacher's foundational *Small is Beautiful* [223], Victor Papanek's *Design for the Real World* [8], and now, Creative Capacity Building [157] as a foundational framework for understanding inclusive development-centered innovation practice. As the field grows, the theoretical foundations can become limitless, as the boundaries of urban planning, service design, human-computer interaction, business development, product design, and Schumpeterian innovation offer interweaving and sophisticated applications of innovation practice. One might ask, in this evolving and further complicated nexus, where do we start?

In this, the Creative Capacity Building literature offers a useful lens, both for innovation and evaluation practice. The growth of innovation practice over the past decade resulted in the application of methods to completely new problem areas, contexts, and practitioners. Botswana's innovation actors – its practitioners, facilitators, policymakers, and researchers - must ensure that the innovation transition is holistic and clear in in its vision. Here are four questions we can ask of the country's innovation activity, to ensure its stakeholders do so.

- **What** problems are addressed through innovation? What solutions are valued, and how?
- **Who** can innovate? Who is given the capability to evaluate?
- **Where** can one innovate, and how is the 'where' involved in the process?
- **Why** innovate?

The 'what' is evident from the analyses. Though a wide variety of issues are addressed with this national shift towards innovation, the problems to be supported by the institutions at bay are important yet limited. Opportunities exist to innovate between the gaps of the National Priority areas of focus; from unemployment to the art and food. The more institutional space given for promising areas of innovation, the more opportunity exists for solution-building. What is also important, however, is that the innovation institutions continue to remain open and receptive to innovation opportunities. The 'what' might change, and institutions should be ready to adapt to those changes.

The 'who' questions are the ones most clearly tied to the concept of inclusion. The institutions of innovation practice in Botswana remain exclusive. Potential innovators who cannot stay in Gaborone long-term, who have little interest in the National Priorities, or without the educational or social capacities relevant to internationally competitive innovations are excluded. However, as is shown by the deep work developed in D'kar, innovation can be leveraged as a collective opportunity to address many issues that plague the impoverished. Developing institutions that afford more communities the opportunity to engage in aspects of this liberating practice -- if they choose to -- is useful. However, facilitating innovation requires more than exposing Botswana populous to its benefits. Innovation activity requires the resources to dream, research, and create; funds, expatriate designers, and in-country experts are yet separated from our D'kar innovators. Alternatively, choosing where those resources should be used is no trivial matter for policymakers; and innovation facilitation is not their only priority. A critical lesson design teaches us, however, is how the practice is essentially educated compromise. Though no solution is perfect, each Pula

spent on a solution reflects the values the institutions decide to espouse. Developing support to facilitate inclusive innovation across the country sends a powerful message.

As was stated before, time is another important dimension when considering the 'who' of innovation. If the goal of the country is to develop a holistic transition towards a knowledge-based society, this means ensuring the 'who' includes the future Motswana. Building creative problems solvers means ensuring inculcation of innovation practice into educational systems in Botswana from the earliest age. As was expressed before, one unintended quality of the innovation center 'silos' are the frictions created when organizations bump up against one another. It is one issue to say that undergraduate innovators and their professors have poor relationships with the stakeholders in BIH and BITRI due to siloed policymaking. It's another issue entirely that the first time they've likely been exposed to innovative practice is during the last year of undergraduate study. There are multitudinous resources about the benefits, theories, and practical possibilities to develop design thinking and creative problem-solving solutions for kids, in school environments, and the like, such as the education framework resources that support Newfoundland in Ecuador [215]. I leave this challenge to Botswana education specialists.

The 'Where' might seem a bit more nebulous, but it altogether just as important. An important lesson of D'kar and Seronga is not just about the people who now have increased capacities to design technological outcomes; it is the focus on their local context. Their lived expertise about the Kalahari Desert the Okavango Delta, and the many other local contexts, are useful and intellectual resources: lessons that can be adapted and utilized for collective benefit. Communities who live in these areas have the best understanding of the land, the relationships, and the resources, and interventionists must continue to leverage this situated knowledge in respectful ways. Though partnering with such colleagues to develop mutually beneficial innovations is difficult, it is a necessary lens for mutually beneficial empowerment. Developing institutions that protect and facilitate the community's capacity to use these resources are also lacking; if these folks are to innovate, those resources must be made available in a way that incentivizes entrepreneurial spirits.

However, there is another way to think about the 'where': not just as a location, but as a category of problems to be addressed. The current innovation institutions of Botswana purposefully direct innovations towards commercial output. What about innovations in the public sector, in health, in political advocacy? A BIH innovator aiming to address the issues of cell phone theft through active registration of phones mentioned that without collective organizing or self-governing bodies of the police, secondhand industry, and primary phone distributors making a commercial case for his innovation -- which could severely hinder one of the most prevalent crimes in the country -- would be very difficult.

> "We try to bring [individual informal sectors] into use our [cell phone registration] platform to verify or to clear anything they want to buy from a database that it truly came from the one who wants to buy [the phone]. If it's not, they won't take it…. They say: If I use your system right now, I will be marginalized by the general public. They will say if I got to my competitors they will say you are checking with that. There is a lot of stuff you have to go through. If you can call all of us, maybe."
>
> BIH Entrepreneur

Immense invisible opportunities exist to innovate not just in the commercial sphere. Spreading methods, building capacity, and developing the institutional motivation to innovate towards problems of various natures must be a priority.

Now, comes the “why.” Admittedly, this question is more difficult to answer. This chapter of the dissertation is rife with reasons, international, national, and local, that were potentially solvable through the spread of innovation practice. In many ways, the local Motswana is disconnected from the resources made available to ask that question for themselves. So, what answer do I have? As I explained in the methodology, I would rather Batswana answer that question for themselves. To do this, I suggest the innovation community develops space for the wide variety of community members to gain access and interest to innovation practice resources, to address the problems they come across. Designers argue the world is up for remaking; both from the ground up, and the top down. Therefore, the question ’why should we innovate’ should be voiced, and answered, by all Batswana who want to be a part of the conversation.

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Chapter 4: Innovation + Ethics

"You tell me this is food but [you] give me saliva instead."

- Ghanzi community panhandler, after receiving half-eaten food while we traveled back from D'kar.

Design Ethics Quandaries: Two Cases in Botswana

The stories below represent only a few of the many ethical quandaries I had a chance to observe while conducting the research and represents even fewer of the many ethical issues innovators grapple with when engaging in development-based innovation practice. When developing these types of interventions, ethics are an especially important consideration because, as mentioned previously, these entrepreneurs live on the border of the unknown while interacting with particularly precarious populations. The purpose of the narratives below is to describe how **current ethics institutions have trouble adapting to the needs, outcomes, and complexities of innovation practice**. I start by outlining two events I experienced in Botswana, and how decisions made while innovating created predicaments with no simple solution.

During the Seronga workshop, there were many different stories that made me question how I interacted with the community. Because I had arrived a bit later than expected, the teams had essentially been chosen to work on projects, and I had to decide if I would join a project or stay back and observe the total workshop. I decided that I wanted to see the activities, outcomes, and dynamics of the full workshop. By being a floating researcher, moving from team project to team project, I wouldn't infringe on any existing team dynamics. Moreover, I would have the opportunity to learn from all the team activities at once and observe how the CCB methodology influenced multiple teams. There were several times during the workshop, however, when I asked myself if I should become more involved.

In one instance, for example, I questioned my role with a team that was working to develop a chicken wire fence technology. One of the villagers had an issue she brought directly to the community. Her plants were being destroyed and eaten by the rodents in the area. Although the primary focus of the CCB workshop was focusing on human-elephant conflict, she was persistent enough to make sure the CCB addressed her personal issues. So, the team came up with a solution where they intended to buy chicken wire and then bury it under the ground. If the chicken wire is buried far enough below ground, rodents cannot successfully break through to burrow under the fence.

However, the villager objected; she said she had tried this before, and the fence had broken down in the Okavango soil over a few years of exposure. However, the villager couldn't fully explain why the fence broke down. English wasn't her first language, and this contributed to her inability to communicate with the rest of the team. The other design researchers decided to progress with the project because they assumed the pure soil couldn't break down the chicken wire metal. Eventually, they developed a prototype fence, and the buried Chicken Wire prototype was the intervention that they presented at the end of the CCB summit.

I asked other farmers in the summit who were a part of another team whether the fence would work, and they agreed with the villager that it would not. They explained that the Okavango River's salt and other mineral deposits were deeply ingrained in the soil chemistry, and over the many years the intervention would have to last, the chicken wire would eventually break down. At this point of the workshop, I knew I had the engineering acumen, the capacity to communicate, and the privilege of being an American citizen, which meant the design team would more likely listen to my concerns. However, this issue made me pause. As a potential participant, my input might help this team develop a technology that would better benefit the Okavango villager. However, I had decided to act as a wandering researcher from the beginning, instead of a team participant.

This team had been working on the problem nonstop for five days, and they might have had further expertise on why the solution would have worked. Was I even sure I had the whole story right, and did I even catch all the considerations the team had made? Would they even accept what I had to say?

This specific issue even made me question why I had come to the workshop for in the first place. The fact that I had the opportunity to talk to multiple teams is the main reason why I had the chance to corroborate the villager's claim, but the distance I developed with the team might also be one of the main reasons why I felt so concerned with sharing the information in the first place. Moreover, if I involved myself too much in the process that might infringe on the "data" that I would have otherwise collected in this design process. By refraining from direct involvement, I could catch more diverse information from each team, watch dynamics as they unfolded and reflect on them instead of becoming a part of them by interacting. But, were my research principles more important than wasted time, a potentially failed design, and a villager with a sour experience with innovation practice? A situation like this offers an interesting researcher/designer quandary: *do I report this issue* to influence the summit and the further development of a potentially failed technological intervention, *or do I back off* and report the dynamics as a point of concern while letting the experience play out? By the time I could decide, it was too late to change the project the team was developing. Should I have asked the design team why they thought the fence would last? Should I have latched onto the team more, to ensure the project would become more successful? Though it is unclear that further intervention on my end would have addressed this issue, in the end, I had to cross my fingers and hope for the best for everyone involved. What I could do, however, is reflect on my positionality as a researcher and innovator and offer the narrative so all inspired innovators can do the same. There are no flies on the wall in a design workshop; participants can never be entirely separate from the community but by failing to join a design team to benefit my research, I failed to build the social trust that might have revealed a better design solution. In a different context, with a different researcher, and while solving a separate issue, not intervening might have been the correct decision. Designers must grapple with those decisions every day in the field: Where do my allegiances lie? What matters the most? How can my research methods or principles, or the design activities, be augmented to better align with a community' collective needs as we move through the dynamic process?

In D'kar, after the community presentation for the wheelchair, Hùiku had an opportunity to figure out how to develop a plan for continuing the prototyping, business planning, and vetting of the wheelchair project. On the last days, we were given a technical review by a chosen collection of mentors, including wheelchair experts and service providers, University of Botswana professors, IDIN representatives, and other design facilitators. And at the event, we learned and talked about various engineering and user experience qualities of the existing wheelchair prototype, the advantages and disadvantages of our decisions, and opportunities for moving forward.

One of our colleagues mentioned a critical piece of information: 'I hurt myself on the chair.' We asked how, and the professor pointed to a small bolt at the edge of the main girder, noting that we did not fully saw off the bolt when we connected the front caster to the original wheelchair frame. Though it would have been simple to fix before the project, we decided to focus on other design priorities before the completion of the chair.

Though that was an easy fix, there were other safety issues we failed to address. As mentioned in the previous chapter, we developed a collection of metrics to make sure our intervention was better than the current product. One critical metric of a successful chair prototype was safety: the wheelchair must be stable, it must have the appropriate seating cushion and ergonomic structure, and it cannot have parts that might hurt the user. However, the intense time and resource constraints of the summit made it difficult to keep track of all the issues. Because we focused on trying to finish the project quickly and directed our focus toward the technical innovations such as the wheel and torque mechanisms, we lost focus on ensuring the wheelchair was sufficiently safe. Our armrests had pinch points and sharp edges, which were the exact design requirements we told ourselves to avoid before we settled on a final design nearing the end of the workshop. Ergonomically, the levers required the rider's arms to be located a bit too far away from the body, which over time could contribute to carpal tunnel and other related chronic injuries. Developing a wheelchair that simultaneously develops our established solutions for rolling on deep sand, while addressing these wheelchair issues, remains a problem for future wheelchair developers.

One could pose the argument, however, that the wheelchair isn't yet available as a product, and thus it is reasonable that such design deficiencies exist on this prototype. Finalizing the product would require months, even years of consultation, development, and testing of a wide variety of stakeholders including service providers, manufacturers, mechanical/materials engineers, business experts, and others. If the designers worked effectively, they would eventually address these issues from the IDDS prototype. So, why should the topic even be mentioned in the first place?

The answer must take into context the reality of the D'kar community. To the citizenry (and in full disclosure, to some of the amateur wheelchair designers who made the product in the first place), the wheelchair *looks complete*. During the village design review, the chair was tested by people with disabilities, by chair designers, and by children. It required the gaze of two wheelchair design professionals and an ergonomics professor to find these issues we missed. Were they to be implemented, the previously mentioned design iterations to improve safety would require extensive human, social, technological capital that does not currently exist in D'kar. Multiple conversations with those who became chronically injured in the community revealed the most extreme cases of disability were exacerbated by limited access to medical facilities in the area. As a result, if these issues were not appraised and taken care of immediately, the chair we made to help D'kar citizens might end up causing more damage than we could have ever known. So, *what good have we done if our intervention harms those we aim to help?* How do we ensure "look alike" prototypes don't become the main practical outcomes of innovation workshops, and if they do, what complementary activities can remedy the incomplete development of these technologies?

Challenges of Institutionalized Ethics of Design for Development in Botswana

The insights in these narratives represent a larger reality: Innovation practitioners, and global development interventionists, have few resources that can guide, support, and review their activities though lenses of ethics. While we design, we aim to turn our existing world into a more preferred one; this was clearly our goal on the wheelchair project, and while addressing human-elephant conflict. Botswana has a storied history of interventionists who misrepresent and exploit the resources, experiences, and culture of the San for personal gain. Researchers have investigated the San in culturally blind and dehumanizing ways, their stories have become officialized and rendered as truth, and the San have been robbed of the ability to tell their own stories.

Knowledge production by outside scholars often serves to legitimize the institutionalization of colonialist policies. As an example, anthropologists working in Botswana officialized their narratives about the San's lifestyle and experiences, building a knowledge foundation for policies that separated the Khoisan from their ancestral lands [1].

Fortunately, institutions have been built to advocate, support, and empower the many San communities in Botswana. UBTromsø, a program that outlined a collaboration between the University of Botswana and the University of Tromsø, developed into a research institute focused on San issues [224]. Prior to UBTromsø, in the 1980s and 1990s, a dozen studies were commissioned by the Norwegian Development Agency (NORAD) in the 1980s and 1990s to develop a dozen studies commissioned to provide baseline data and assess projects in districts where the national government implemented RAD programs. After Sidsel Saugestad filled the role of 'research facilitator' located in UB's predecessor to the Office of Research and Development, she focused her research on the intricacies of Botswana attitudes towards the San, with a more direct focus, as prioritized by the University of Tromsø, on state policies for indigenous minorities. This research also evolved into her text, *The Inconvenient Indigenous.* While Saugestad's first foray made a significant contribution, her work made clear that a single post by an expatriate researcher within just two years could in no way document the social and cultural dynamics of the many various San groups in the country and the challenges of accommodating this diversity through national development policies. Therefore, she spearheaded a program that facilitated a longer-term, multi-pronged, resource-capable program aligned towards San issues. The fundamental focus of the program was to build capacity for research aligned with San issues. According to Saugestad, there were many good reasons to start such a program:

> "First was the situation on the ground for the San and the need for changes in policy, and the need for applied research to promote such changes. Thirty years after independence, and despite well-intended development projects the San reminded a marginalized and disempowered minority.
> Second was a finding that the considerable research undertaken in connection with remote area development program was not cumulative. Due to the time constraints of commission research, each study appeared as a case study without further generalizations.
> A third reason was at considerable and high-quality research on the San had for decades been undertaken by researchers from South Africa and overseas. It was simply considered that it was time at quality and sustained research should be undertaken under the auspices of the University of Botswana, to develop national skills and make research more easily accessible for users [224]."

The program engaged in various support activities: from hosting research conferences to supporting research grants, scholarships, study trips, and San Youth Capacity Building Projects that used affirmative action programs to recruit students with minority backgrounds into academic communities. To date, over 500 San students have received training from the program. Recently, the San Research Centre, the office that came of the collaboration, has become central to fulfilling the University of Botswana's mandate for 'social responsiveness' and 'community engagement', outlined in the University's Strategy for Excellence [144]. They also contributed largely to the publication of a San Code of Research Ethics in 2017, the first affiliated code in the Global Code of Conduct. It describes a focus on facilitating research collaborations based on respect, honesty, care, justice and fairness [225]. Today, the Research Centre continues to support research that involves San communities of Botswana in efforts to help improve San communities and livelihoods [226]. Researchers require authorization from the San Research Centre to design and conduct research that empowers and humanizes San communities. First, affiliation with the center

needs to be acquired; then, a researcher must obtain Institutional Review Board (IRB) certification from an institution, such as the University of Botswana; and finally, the IRB approval is sent to the Ministry of Local Government and Rural Development.

The San Research Centre is nowhere near the only institution that regulates research in the country, much less the only one at the University of Botswana. As mentioned previously, other programs include the Okavango Research Institute (ORI), Centre for Scientific Research, Indigenous Knowledge and Innovation (CESRIKI), Centre for Study of HIV&AIDS (UBCSHA), and the Centre of Specialisation in Public Administrator Management (CESPAM). Each program has its own purpose, purview and process used to disburse research permits. Although there are national pressures to develop a research information management system that facilitates all national research activities, including research permit application and issues of research ethics, these resources are to date absent to researchers [144]. I became intimately associated with this process precisely because I was initially forbidden from conducting research activities when I entered the country and was required to navigate the process myself during my research. Ensuring these ethical requirements are standardized, clarified, and made available to researchers in Botswana and abroad would facilitate growth and improvement in research.

The International Development Design Summit, however, is like other design projects in how it is not classified as research, and thus is not covered by the purview of the San Research Centre or other related institutions. The Center aims to regulate researchers working towards theses, dissertations, or peer-reviewed publications. Although the IDIN partners did collaborate with the San Research Centre to ensure they approach and connect with the communities ethically, it was clear that no research would be conducted, and no permit would be required. The case could be made, however, that the design work had the opportunity to cause more immediate direct consequences. The malevolent researcher could (and has) entered, and exploited, obtaining information from the San community, which would cause long-term harm. A wheelchair defect, seen by the community as a completed product, could have scraped or impaled a member of the D'kar community, which could harm the members instantly, while also potentially contributing long-term exploitative harms as described in the previous chapter. Though our IDDS designers would likely never intend to harm the community they meant to help, the consequences might be hidden and altogether more harmful.

Design for international development doesn't just exist in D'kar, or only as a part of the International Development Innovation Network. There are a wide variety of projects that have the intended purpose of helping those in abject poverty through the methods of innovation practice. Actors in many different contexts are getting involved in systematizing emergent innovation development, and this is seen broadly as a good thing. Moreover, many self-identified designers have gotten in on the ground floor towards inculcating design thinking work for development. However, this means there are more opportunities for interventionists to inadvertently harm the end users, echoing inadvertent processes of harm in the past. Innovators must begin to ask themselves: how is my presence as a designer, and the outputs I develop, potentially endangering the members I aim to help? This requires designers to do more than discuss how designs fail. Rather, designers must work through the unexpected negative consequences of success. They must ask themselves: how can target beneficiaries be physically, economically, emotionally, maybe even be institutionally damaged by these interventions?

One would expect that everyone conducting this flavor of work has a sturdy moral code. Even so, making the correct decision is especially difficult when there is no clear right solution, as in the situations above. Designers are to blame, however, if they do not consider scenarios where we do what designers have done for decades: thinly veil harmful behavior with good intentions. We must consider that the obvious fact that the interventions we create, in the small amount of time we have with the end user, can harm instead of helping. These topics discussed above and many others in a variety of design contexts represent *essential ethical questions that must be addressed if we as a community are to engage in positive change*. Doing so practically, however, remains a gap in innovation practice.

Institutional Mismatch: The Need for Ethical Frameworks in Innovation Practice

Regardless of whether development interventionists acknowledge them or not, the projects they involve themselves in are rife with ethical quandaries. Whether the context is collecting data from an indigenous community on the development of a wheelchair or developing IP policy that facilitates the protection of indigenous knowledge, the values that stakeholders try to manifest during this work are based on the ethics they decide to prioritize. Professional communities often have a system, code, or guideline of their collective professional ethics upon which to draw. Design communities have attacked this concern as well; for instance, in the Stanford Social Innovation Review, publishers suggested a code of ethics based on ensuring innovators "do no harm" while engaging in development activity. Though innovation practitioners are no different, the amorphous and juvenile nature of the field means that such standards have not been broadly adopted.

However, formative specialists in the field are starting to develop a foundation. For instance, the Stanford Social Innovation Review posted a piece that lambasts the adoption of certain parts of the innovation culture without focusing upon the needs of the target communities. They state innovation practice must be simultaneously humanistic, non-hierarchical, participatory, and sustainable. More specifically, they suggest new principles that innovators should adopt when intervening on behalf of the marginalized: designing with the user, understanding the existing ecosystem, designing for scale, building for sustainability, being data driven, using open standards, open data, open source, and open innovation, reusing and improving, doing no harm, and being collaborative [10]. The World Design Organization, renamed the International Council of Societies of Industrial Design, has also developed a Code of Professional Ethics that "provides an outline of ethical guidelines designed to advance the quality of the industrial design profession [227]." The categories of interest include benefiting the client, benefiting the user, protecting the earth's ecosystem, and benefiting the profession of industrial design.

Ethics has become institutionalized in certain professional contexts to ensure that all parties adhere to set guidelines when engaging in potentially hazardous practices. One of the most broadly acknowledged institutional systems that exists to standardize, communicate, and regulate ethics practices in research and academia is the Institutional Review Board (IRB) system. A key goal of IRBs is to protect human subjects from physical and psychological harm. Projects such as the studies of Nazi physicians, the Tuskegee Syphilis study and human radiation experiments during the Cold War developed pressure to create the National Research Act of 1974. These controversial projects also sparked the development of the Belmont Report, which outlined primary ethical principles in human subjects review as "respect for persons", "beneficence", and "justice". IRBs are governed by the Title 45 Code of Federal Regulations Part 46 [228]. These regulations define

the rules and responsibilities for institutional review of all research that receives support, directly or indirectly, from the United States federal government. Boards such as these were incited by reprehensible human rights abuses of Nazi physicians as made known by the Nuremburg Trials [229], or the political fallout of the publishing of the Tuskegee Syphilis Study [230]. Botswana uses these guidelines in their IRB system as well. However, there are specific reasons why these ethics institutions fail to align with beneficial innovation practice. By looking more in-depth at the IDDS context and how they practiced design, and thinking about how design practice manifests globally, we can investigate why this is the case.

One issue is the evolving and specific context in which designers find themselves. The IDDS Creative Capacity Building method, which prioritizes applying teams to develop local solutions to development problems, is applicable in a wide variety of contexts. The work described in this dissertation spanned several contexts, from desert livelihoods, to refugee empowerment and facilitation, to climate change adaptation. For many of these projects, an essential activity of the design process was problem finding: ensuring the design team accurately assessed the problem before progressing to other stages of the process. This process requires that innovators learn as they go, use contexts to build understanding of the issues, and adapt to unexpected challenges. When applying for an IRB, however, success hinges on the researchers' ability to formulate and adhere to a focused research question throughout the implementation of the research project. How can innovators be expected to evolve, and adapt if the ethics board that allowed the project does not allow them to do so?

Another issue is how innovation practice is designed to attract 'amateur' designers. IDDS aimed to attract designers with a wide variety of disciplinary backgrounds to help address the local issues of these communities while introducing new practitioners to the benefits of the IDDS methodology. IDDS intentionally selected participants with varying degrees of experience applying innovation practice methods and mindsets. At IDDS Botswana, many of the participants had never experienced a design cycle as in-depth as that which took place during the summit. What is important here is that IDDS, and other design projects, were purposefully designed like this, so the tools and methods of innovation practice could become available to stakeholders typically marginalized by their identities or professional responsibilities. This can be placed in stark contrast with other professionalized disciplines, such as engineering and medicine, which have highly rigorous ethics and accreditation systems to ensure their workers conduct ethical work aligned with their expertise, and resources that can guide them on the path of ethical practice. Without the professional resources of other institutions, how can amateur designers be expected to adhere to rigid ethical guidelines, and how would they be developed in the first place?

Another issue is the remote design problem. Particularly in design for development, those who engage in design work, influenced by the hegemony of international development culture, mainly develop interventions far away from the communities targeted for the interventions. The designers are often systematically disconnected from the communities they aim to help. This presents itself in a wide variety of communities and has also been discussed as a point of concern in the field of design for development [31]. Additionally, in my study of human-centered design in OpenIDEO, I outline a system designed to facilitate remote innovation practice; in this system, very few designers directly engage with the targeted beneficiaries when developing their main ideas [231]. Although IDDS directly addresses this issue by bringing participants from all over the world to the site locations they intend to influence, the few weeks of the summit is nowhere near enough

time to harness their collected expertise into a manufacturable product. Moreover, many other design houses do not adopt this model and design far from their target locations. Design decisions are less likely to be made by the communities who will obtain the projects, and there is a higher likelihood for communities to develop interventions that don't take the end users into account. This is also an ethics problem: what in good faith can a designer suggest as a beneficial solution intervention when he/she lacks sufficient grounding in the cultural realities that are only discernible through designer-user proximity?

Another issue is that much of the innovation process operate during the early stages of the design cycle. Innovation practice is exceptionally useful for generating many ingenious, interesting ideas to address wicked problems of our society. However, reaching past the development and design phase to develop a sustainable intervention is much more complicated, requires more resources, and easily fails if it doesn't have a designer with an entrepreneurial spirit, connections to move it forward, and luck to be developed sustainably. This is manifested in many other contexts, as well: countless projects in design thinking courses never reach past the classroom, because students lose interest, funding and network opportunities fall through, and the students in these courses aren't close enough to make decisions that sustain and evolve the intervention past the rapid design stage. Another example is prevalent on OpenIDEO; in the project that aimed to develop solutions to address how children in impoverished communities rarely live past five years old, 440 ideas were suggested, and the challenge sponsors eventually supported only thirty-one ideas [232]. What does this mean in practice? A large collection of these designers who aim to address global poverty issues, might not actually develop into a form they expected. There was a direct example that happened in the IDDS wheelchair team: because the community had few wheelchair riders and did not have direct access to wheelchair service providers, we concluded the development of a deep sand wheelchair would be more sustainable, profitable, and most importantly, spread to a larger differently abled community by bringing the wheelchair design away from the D'kar innovation site. These issues, however, also have an ethical dimension: the very act of entering a community in a wide variety of contexts means the community members expect results from the expatriate designer. How do designers who thrive in the early stage of the process ensure and supplement their actions with sustainable consequences the community cares about? Or, if they cannot, how does a designer hedge their contributions, and how do ethics institutions remain flexible while holding designers accountable?

Broadening the Scope: Gaps in Ethics Institutions supporting Innovation Practice

Unfortunately, the research-based human ethics boards are too regimented to support the amorphous and evolving dynamics that innovation practice requires. If such an institution doesn't give us what we need, where do we start? Fortunately, there are multiple fields which investigate the ethics of design work from which we can draw upon. One critical contribution was made by Paul Atkinson, in 'Ethics and Ethnography' when he found misalignment between biomedical ethics boards and ethnographic practice. Similar to design practice, he unpacks how ethics institutions require hard-lined compliance of ethical values, such as informed consent, the right to withdraw from a study, and minimizing risk. However, ethical quandaries consistently in the gray areas of research work. For instance, clinical trials, when doctors offer diverging opinions on the diagnosis of certain illnesses, and the diagnostic criteria were not clear-cut. Additionally, this is present during informal consent research procedures which rarely give guidance on the 'relational and sequential' nature of consent, like if during a school study a single student can change their

mind about participating in the study. Moreover, he reaches a similar point about the evolving nature of ethnography: "It is, after all, possible to discover issues that are critical of the institution or association studied, quite unpredictably, that cannot be incorporated into undertakings before the event." To begin to resolve these issues, the author suggests a long term-vision towards refining research protocols that are directed by values, instead of hampered by procedures; where ethnographers describe and outline the values of ethical research in their practice [233]. These insights clearly align with the evolutionary and adaptive needs of innovation practice; however, more dimensions of precariousness are complicated by amateur innovators whom operate without institutional oversight. Moreover, the activity of innovators is clearly of a more interactive nature: they don't just ask, and observe, they co-create, develop, and test alongside their target communities, which opens the possibility for further ethical ambiguity. Professional researchers may aim to evolve the IRB systems they become a part of, but IDIN-based designers still yearn for ethical tools adapted to their needs and which consider their values.

A useful yet understudied field that builds a useful foundation is development ethics. Catalyzed by Goulet's, "The Cruel Choice: A New Concept in the Theory of Development" in 1971, the field tackles this overarching ethical question: "What are the requirements of the good life and of the good society in the modern world?" Goulet lists that development ethics aims to debate topics in four separate arenas [234]:

- debates over **goals**: economic growth, the provision of basic needs, cultural survival, ecological balance, transfers of power from one class to another;
- divergent notions of **power**, legitimacy, authority, governance, competing political systems;
- competition over **resources** and over rules of access to resources, competing economic systems; and
- pervasive conflicts between modern **modes of living**—with their peculiar rationality, technology, social organization and behavior—and traditional ways of life.

In this way, the field aims to be the "conceptual cement that binds together multiple diagnoses of the problem with their policy implications through an explicit phenomenology study of values which lays bare the value cost of alternatives courses of action [234]." A critical underlying theme of this dissertation research is outlining the complexity, fluidity, and evolving nature of innovation practice, and illustrating how inflexible tools fail to align with how the field operates. The case of design interacting with existing IRB institutions not only reveals that such institutions limit its complex nature, but that that design practice cannot divorce itself from the institutions in which it is situated. As was explained before, though IDDS organizers did not have to engage with the IRB community, they acknowledged the knowledge, power, and history by which the San Research Centre had access and utilized the Centre's guidance to facilitate the development of a culturally competent innovation community. As argued by Denis Goulet, "ethical thinking must become 'the means of the means'…. a moral beacon illuminating the value questions buried inside instrumental means appealed to by decision-makers and problem-solvers of all kinds [235]." It is encased in and can guide relationships between people, organizational structures, policies, attitudes – and in the case of IDDS, the process of innovation as well. Transdisciplines such as development ethics, which adapt and contribute to a litany of other fields, can be better aligned to holistic innovation practice than can any single ethics institution – and innovation practitioners can better use the approach to guide ethical practice.

After interrogating their colonialist and imperialist roots, ethnographers have a sturdy foundation in ethics and have taken strides to integrate their insights into the field as a whole. By moving towards further participatory methods, by dismantling hierarchically based research, by facilitating the development of co-constructed narratives, and by even integrating indigenous research worldviews, they are working to ensure ethnography is no longer exploitative [236]. Spreading the currently foundational lessons about the ethical quandaries of ethnographic work to the nations of amateurized designers. So, equipped with methods and mindsets of innovation practice, and using the contextual frame of development ethics, where do we start? Here, we focus on the lack of agreed-upon methods for considering the ethics of development-focused innovation. Innovators must ensure ethics tangibly integrated in practice; instead of advising wanton caution, or continually thinking through the practice, it means ensuring designers have the tools to engage ethically with the communities they aim to impact, such that their experience coevolves with the theory. Though there is clear precedence for consideration of these topics from all these fields, there is still intellectual headway to make. Serious conversations about the complicated and evolving nature of ethics in design are still severely lacking. So, how do we begin to image the useful discussion of integrating design ethics for development into current ecosystems of praxis? A critical starting point would be to figure out how to integrate ethics conversation into the worlds of designers effectively. A few opportunities are below.

Potential Interventions towards Aligning Ethics of Design and Development

To develop institutions that facilitate design thinking towards ethics, we must ensure it is a topic of focus in the variety of practitioner contexts. This includes students in universities, private design consultation firms, and public organizations that use methods of innovation to reach their goals. These policy interventions adapt to the evolving nature of design contexts, and the needs of the community for whom they are intended. Unlike more solid institutions, they do not have the backing of ethics institutions who have the power to keep research in check. With time, the communities that become a part of these projects can develop more solid institutions that better align to innovation practice.

Teaching Design Ethics for Development

The paper by Lofthouse and Lilley develops a review of postsecondary programs in multiple types of design, listed as *Teaching Ethics in Design: A Review of Current Practice* while illustrating the different types of ethics questions they ask students to grapple with while progressing through their programs. Many institutions already have developed design coursework that focuses upon the complex, convoluted issues of design in these contexts, including schools in the United States, in the United Kingdom, and in the Netherlands. Each one of these school offers a prime opportunity to develop a directed focus on design ethics, particularly by crafting the newest collection of designers, and by helping them understand their positionality, by developing literature sets on critical documents that bolster the field of design ethics, and by giving ethics material a direct space to be applied, critiqued, and developed through praxis, by being adapted to the critical design projects of the course. The paper also suggests useful techniques in teaching ethics to design students. The methods include role-play or structured controversies, case studies, scenarios, systems thinking, and group discussion [237].

A gap, however, is developing educational resources located at the unique nexus of design for international development. Developing syllabi that interrogates the knowledge of development practice and ethical quandaries of the work. At my home institution, courses such as the recently established DEV200: Design, Evaluate, and Scale Development Technologies, and CE209: Design for Sustainable Communities at the University of California, Berkeley, which offers tools, teaches methods, and holds space for designing development technologies in various impoverished contexts, are prime opportunities for developing such syllabi. While developing this work, however, it does help to start with critical resources to start the conversation around ethics. A great start is the International Declaration of Human Rights, which creates thirty essential mandates for understanding global ethics that should rightly be leveraged towards any human, or activity that includes humans, on this planet [238]. When putting this work into practice, a direct consideration of the scenarios of design projects that might infringe on a community's ethics, and how to design for those issues, should be included as critical topics and considerations assignments for the students.

The Development of an Ethics Ecosystem

We move forward faster when we do not have to remake the wheel. In the frame of information gathering, understanding, and collaboration, we can learn how ethics can be developed and create fora for understanding the field by developing transdisciplinary collaboration spaces for designers in development, for development actors interested in design, and others adjacent fields to share insights. It also makes sense to learn from communities who research and apply these topics; particularly in the field of collective innovation. I call upon the lessons of Prof. Elizabeth Gerber, an innovation professor at Northwestern University, who calls collective innovation "a process that harnesses the diverse and untapped human, social, and economic capital from distributed networks to discover, evaluate, and implement new ideas [239]." She puts her ideas into practice through her community initiative, Design for America. Headquartered at Northwestern, the community that aims to develop communities, projects, and people who catalyze innovative interventions to complex problems. These communities should be brought into the discussion to ensure the frameworks of design ethics for development include as many useful stakeholders as possible [240].

Research on ethics quandaries

The growing body of research on design and ethics practice affords us many opportunities to interrogate the principles that innovators adopt when addressing issues of abject poverty. Here, I present two method sets to probe the literature, to enhance our understanding at the nexus of ethics and design:

- Studies that synthesize existing case studies of design work for development, with a focus on the design practices, the design outputs, and the outcomes of the work completed, and
- Reflections that unpack and critique ethics theory within a design framework, illuminating ethical issues that should be critically considered in design.

We must continue to push research, and applied investigation, particularly for this reason: integrating ethics into design for development is, itself, a wicked problem to be addressed. That, however, is the only resolution of which we can be certain. As in the previous chapters, the questions of who, when, where, and how remain unanswered. Who should be charged with doing it, and how? When should ethics considerations be done effectively and tangibly during the process? How does the 'where' of the practice influence 'how' it should be done? How far should we go in influencing, controlling, and developing responsibilities for, problematic design scenarios? I hope to include the design community in this conversation and ask exactly how we would begin thinking about design and ethics.

To sum up, I paraphrase, with a quote from Herbert Simon: "design is the practice of turning our world from its current state, to a preferred one." The ethics we establish as a community of passionate, disjointed, widely varied innovators become the critical foundation that determines whether our future world can be a better one. If we are to engage in moral work, we must make sure to consider our collective ethics in any action we participate in, especially if our main directive is to do the beneficial 'development' work. However, to do this correctly, praxis is necessary when answering these questions: not solely theory or action, but both consistently and fluidly influencing each other while developing our answer. Our work is hard. The ethics of our profession are inextricably tied up in the culture of our environments. I admit that these suggestions can, and should, be up for debate and discussion. Should they exist? How would they be implemented? Who becomes liable? However, with the global awakening of design as a profession, there will only be more integration, intervention, and cause for inquiry about our impacts on the world. There is no better time to start practically thinking about how to develop design ethics for development than now.

Where do we go from here?

"Thus much of my current work requires that I stay light on my feet and responsive—making the path as it is walked and crafting the bridge as it is crossed. Nevertheless, with a mindful increase in such developmental practices as part of the ordinary rhythms of professional (as well as personal) life and work, we each will walk with greater and more authentic alignment of our espoused values, beliefs, principles, and commitments [241]."

Prof. Hazel Symonette

While visiting the 2016 American Evaluation Association, I found out too late that the development professional Robert Chambers gave a plenary session where we wore a shirt that outlines how I personally approach design practice. The shirt had the words "Eclectic Epistemological Pluralism" on the front. Because I missed his plenary session, it took some discussions with some mentors before I could understand what he meant; but when I did, I learned how well it fit the evolving field of innovation. There are many various threads that interweaved through the main studies presented in this dissertation. In each of the projects, I found the analyses leaning towards issues of participation, emergence and adaptation, and the utility of telling stories to facilitate the research narrative I condensed here. Though the insights are many and contextual, and difficult to cohere into single, simple insights, one of note is the complexity and adaptability of the of innovation practice.

The first chapter discussed in depth how the field has evolved and been applied over the few years it has garnered interest from the research community. Although the project started as an introduction into understanding how human-centered design for development is practiced, it evolved into a broader understanding of the characteristics of the field. By developing insight around the history, breadth, influences, and outcomes of innovation practitioners, it showed how amorphous the field is, and how tried-and-true methods to support knowledge generation, such as the systematic literature review, are not geared to apply to innovation practice.

The second chapter aimed to ask how innovation actors evaluate initially as a study of a single innovation summit held alongside an innovation community in Botswana. It evolved into an extensive multi-scope analysis weaving historical narratives, national policies, and grassroots technological design. Though the country has worked to grow a knowledge-based society by developing institutions who integrate entrepreneurs, technologies, and researcher at its base, the resources that are used to evaluate the impact of these interventions in its best form must be able to evolve to the dynamic needs and values of its users and contexts.

The final chapter was a purely coincidental reflection caused by me being in the right places at the wrong time and evolved into a discussion about institutional inadequacies towards innovators concerning ethics. It is clear how yet another institution, this time institutional review boards, did not have innovation practice fall under its purview, and is also a bit too rigid to allow for the fluid nature of effective design practice.

What, then, do these chapters say about innovation practice for development? For one, it shows how the institutions we have built have served our purposes wisely. In many ways, they've built bridges to further knowledge and understanding for a litany of different fields. For a transdisciplinary field as this one, however, if we look closely, we can start to see how these methods are unable to bend and twist to the fields' dynamics. These are some of the consequences of a field designed to operate at the edge of understanding. Tried and true frameworks become limiting, communities who set visions and purpose fail to serve the needs of the entrepreneurs, and even the field itself becomes more encompassing and adaptive as it grows to encompass even more innovators. *The bounds of innovation practice, like air itself, expands to fill the containers of the possible*. In the previous studies, we envision the containers as the institutions that support it, the designers that practice it, the researchers who grapple with its characteristics. As a result, the field is as useful as the designers harnessing them and the goals towards which they are harnessed.

Secondly, it shows how 'good' innovation depends on the context. The situations innovators involve themselves in are complex, and what makes a good designer is the ability to tease out the issues in ways to adequately address the 'wicked problems' of the world. How it is done, clearly, is the hard part: we as a community aim to climb mountains never climbed, build bridges never built, and lay plans never imagined, hopefully so we leave legacies that will become useful for the rest of the world. Because of the spread and growth of innovation practice as a field, a much broader community has access to these resources than ever before. During this complex, dynamic process, what matters more than the plan innovators stick with are the tools they can use to find their way and the principles they keep true to themselves as they navigate the unknown. This is where 'eclectic epistemological pluralism' comes in. It means the prepared designer, evaluator, and researchers are diverse and broad in their influences, adaptive in their skillsets and methods of knowledge based on their context. Doing so effectively means remaining 'light on [our] feet and responsive, —making the path as it is walked and crafting the bridge as it is crossed.

In order to facilitate the growth and evolution of Botswana's innovation practice, I must ensure the aforementioned communities can learn from and implement this dissertation's insights. To do so, I will be moving to Botswana and disseminate this research on all topics to all innovation stakeholders I connected with. Many outcomes are possible: for instance, I could develop a participatory history of D'kar interventionist activity, develop a community of ethically-minded development entrepreneurs in Botswana, start a canon of Botswana case studies of informal innovation practice, collect evaluation resources for entrepreneurs and innovation facilitators, and consult on the systematic evaluation of the informal sector in the country. The sky is the limit for these ideas, and the vision shall be directed by the needs of Botswana innovation stakeholders.

The narratives I've collected are fraught with failure and success. There were many points during my research journey where the projects could have ultimately fallen apart. What I drew upon in these contexts were the stories that gave me the tenacity to continue forward. The stories I've amassed, whether they are design projects, case studies, future scenarios, or ethical quandaries, each have something to teach us about the possibilities of the future. In these narratives, the designers can build the context: about who matters, what the history teaches, that forms of expertise might contribute, what interventions should be made, and how one can assess their influence. Though it is not an easy task, it is clearly needed in this world where we yearn for understanding about what new solutions can address intractable problems.

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Appendices

Part 1: Participation Paper Tables. A collaboration between George Moore and Wendie Yeung.

Authors	Title	Year	Participation Level?	Stakeholders?	End User?	Citation #	Query Date
HG van der Roest, FJM Meiland, HC Comijs, E Derksen, APD Jansen, HPJ van Hout, C Jonker, RM Droes	What do community-dwelling people with dementia need? A survey of those who are known to care and welfare services	2009	**with**	people with dementia, informal carergivers, professional caregivers	community-dwelling people with dementia	58	3/30/2015
BE Kolko, C Putnam	Computer games in the developing world: the value of non-instrumental engagement with ICTs, or taking play seriously	2009	**for**	Citizens from Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan ages 15 and older	Citizens from Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan ages 15 and older;	23	4/1/2015
A Lindgren, F Chen, PW Jordan, H Zhang	Requirements for the design of advanced driver assistance systems-The differences between Swedish and Chinese drivers	2008	**with end user**	Chinese and Swedish drivers		20	4/1/2015
ML Best, D Thakur, BE Kolko	The contribution of user-based subsidies to the impact and sustainability of telecenters-the eCenter project in Kyrgyzstan	2009	**for**	employees (managers) of local eCenters (and business partners that hosted them) in Kyrgyzstan, clients of local eCenters in Kyrgyzstan, local businesses partners that might interact with telecenters in Kyrgyzstan; local researchers; USAID representatives; Kyrgyztelecom; CIIP	users that participate in the subsidy program of the centers for either Internet access or computer training	19	4/1/2015
L Barnard, J Wesson	A trust model for e-commerce in South Africa	2004	**for**	ecommerce users in South Africa; companies that host ecommerce sites; expert reviewers	ecommerce users in South Africa;	18	4/1/2015
S Bucolo, JH Matthews	Using a design led disruptive innovation approach to develop new services: Practising innovation in times of discontinuity	2010	**with**	MedCo; medical device manufacturers that provide for developing communities; patinents and their families; medical personnel	patients (and their families) of medical facilities in developing regions;	15	3/30/2015

LM Haverhals, CA Lee, KA Siek, CA Darr, SA Linnebur, JM Ruscin, SE Ross	Older adults with multi-morbidity: medication management processes and design implications for personal health applications	2011	**for**	caregivers of these people (adult family caregivers); Doctors; Pharmacists; Colorado Review board; nurses	english speaking people 65 years or older that take at least 3 prescription medications (1 of which for a chronic medical condition);	14	3/30/2015
W Brunette, W Gerard, MA Hicks, A Hope, M Ishimitsu, P Prasad, RE Anderson, G Borriello, B Kolko, R Nathan	Portable antenatal ultrasound platform for village midwives	2010	**with**	SonoSite, GE, Siemens, Philips (companies exploring portable ultrasound in developing communities); University of Washington; indiginous midwives; radiologist; ugandan obstrotrician leaders; researchers at UW; instructors; ultrasound clinicians; medical and grad student; seattle midwives; pregnant women in developing communities (they are not going to use the machine on themselves)	midwives;	13	3/30/2015
I Hussein, M Mahmud, AW Yeo	HCI practices in Malaysia: A reflection of ICT professionals' perspective	2010	**for**	MCMC; government agencies; interviewees; MAMPU	[none]	11	4/1/2015
T Gorman, E Rose, J Yaaqoubi, A Bayor, B Kolko	Adapting usability testing for oral, rural users	2011	**with**	village chief; representataives of the "Literacy Bridge" company; farmers; local staff	"oral", rural users	11	4/1/2015
C Putnam, E Rose, R Walton, B Kolko	Mobile phone users in Kyrgyzstan: A case study of identifying user requirements for diverse users	2009	**for**	researchers from UW; members of CAICT	citizens of Kyrgyzstan;	10	4/1/2015
SG Mougiakakou, E Kyriacou, K Perakis, H Papadopoulos, A Androulidakis, G Konnis, R Tranfaglia, L Pecchia, U Bracale, C Pattichis, D Koutsouris	A feasibility study for the provision of electronic healthcare tools and services in areas of Greece, Cyprus and Italy	2011	**for**	health care providers and personnel; physicians in this region	patient users of eHealth tools in the Southeast Mediterranean region;	10	4/1/2015
N Poosanthanasarn, C Lohachit, W Fungladda, S Sriboorapa, C Pulkate	An ergonomics intervention program to prevent worker injuries in a metal autoparts factory	2005	**with**	management in metal autopart factories; head safety officer; administrative staff	male employees working in metal autoparts factories	10	4/1/2015

M Yunus, T Sibieude, E Lesueur	Social Business and big business: innovative, promising solutions to overcome poverty?	2012	**by**	Veolia Water; Eric Lesueur (member of Veolia Water's senior management team; Professor Muhammad Yunus; Grameen Health Care Services; Veolia Water AMI; Drishti Research Center;	poor communities in Bangladesh (Goalmari arsenic poisoned well)	8	4/1/2015
P Chininthorn, M Glaser, A Freudenthal, WD Tucker	Mobile communication tools for a South African Deaf patient in a pharmacy context	2012	**by end user**	research team (South African & European); local (South African) Deaf NGO; ICT Developers; industrial designers; Deaf education specialist; Doctor, hospital staff, SASL interpreters, Telcom;	a Deaf Patient in South Africa (and/or) Pharmacists that interact/provide for Deaf patients in South Africa	8	4/1/2015
KL Kumar, M Bhattacharya	Designing for learning effectiveness across borders in a multicultural context	2007	**for**	University of Botswana	students of online courses	8	4/1/2015
JS Sandhu, P Altankhuyag, D Amarsaikhan	Serial hanging out: rapid ethnographic needs assessment in rural settings	2007	**for**	Asian Development Bank (ADB); International Research Development Council (IRDC); health care professionals; workers in Mongolia; mothers and young children in Mongolia;	rural communities in Mongolia (eligible to receive health care);	8	4/1/2015
T Mullaney, H Pettersson, T Nyholm, E Stolterman	Thinking beyond the cure: A case for human-centered design in cancer care	2012	**for**	Norrlands University Hospital (NUS); cancer patient caretakers at NUS; cancer patient family members; dose planning nurses; doctor; staff members; uncologist; radiologist;	cancer patients receiving radiotherapy treatments in NUS	8	4/1/2015
JS Sandhu, J Hey, C Newman, AM Agogino	Informal health and legal rights education in rural, agricultural communities using mobile devices	2005	**with end user**	industrial design students from California College of the Arts; first-year engineering students from UC Berkeley;	Spanish and English speaking farmworker communities in Earlimart, California	8	4/1/2015

R Hinman, J Matovu	Opportunities and challenges for mobile-based financial services in rural Uganda	2010	**for**	FINCA's lead field agent in Victoria Basin, manager/field agent for Victoria Basin Micro-Finance Cooperative; MTN; Zain; bank representatives;	mobile phone users in rural Uganda	7	4/1/2015
A Hashizume, T Yamanaka, M Kurosu	Real user experience of ICT devices among elderly people	2011	**for**	mobile phone providers in Japan;	"elderly people" in Japan	7	4/1/2015
R Walton, B DeRenzi	Value-sensitive design and health care in Africa	2009	**with**	health workers and patients at rural homes and clinics; Ministry of Health (MOH) -- a local nonprofit organization; supervisors in district-level and province-level offices of the MoH; decision makers at the national level of the MOH; CommCare; Financial Donors; drivers (delivery of vaccines);	Health workers, supervisors, NGOs, and MOH Officials	7	3/30/2015
R Steinbeck	Building creative competence in globally distributed courses through design thinking	2011	**with**	Stanford University; global academic partner universities; professors, instructors and teaching assistants from Stanford and global partner universities; industry liasons;	ME 310 students at Stanford	7	4/1/2015
DK Rosner, M Ames	Designing for repair?: infrastructures and materialities of breakdown	2014	**by**	One Laptop Per Child (OLPC); Fixit Clinic; SWIFT banking group; Inter- American Development bank; community organizers; children users; Paraguay; teachers; other banks	consumers with broken devices; Inter- American Development bank, Itaipu Dam,	6	4/1/2015
R Walton, J Yaaqoubi, B Kolko	What's it for? Expectations of Internet value and usefulness in Central Asia	2012	**for**	Central Asian Information and Communication Technology (CAICT) project partners; BRiF research group; University of Washington;	internet users in Central Asia (Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan);	6	3/30/2015

A Dekhtyar, J Goldsmith, B Goldstein, KK Mathias, C Isenhour	Planning for success: The interdisciplinary approach to building Bayesian models	2009	**with**	computer scientists, anthropologists, and welfare case workers; AI group at University of Kentucky; case managers; advisees; Bill Clinton;	people on welfare	6	4/1/2015
S Ahmed, DA Nelson, PA Biedrzycki, MG Sandy, S Opel, Z Franco	Community Engagement for Translational Disaster Research: Fostering Public, Private & Responder Group Partnerships	2012	**with**	researchers conducting community-level interventions; local public health agencies (LPHAs); Center for Disease Control and Prevention (CDC); American Red Cross; NIH; first responder groups; government;	a target local community (crisis victims)	6	4/1/2015
C Driesbach, R Walton, B Kolko, A Seidakmatova	Asking Internet users to explain non-use in Kyrgyzstan	2009	**for**	CAiCT; BRiF; UW; Kyrgyzstan telecom; elcat asia . . . ;	internet users (and non-users?) in Kyrgyzstan	5	4/1/2015
WARWM Isa, NLM Noor, S Mehad	Culture design of information architecture for B2C e-commerce websites	2009	**for**	e-commerce websites;	Students from Muslim e-commerce users;	5	3/30/2015
LC De Castro Salgado, CS De Souza, CF Leitao	On the epistemic nature of cultural viewpoint metaphors	2011	**for**	(we skipped this one accidentally)		5	4/1/2015
A Joshi, M de Araujo Novaes, J Machiavelli, S iyengar, R Vogler, C Johnson, J Zhang, CE Hsu	A Human Centered GeoVisualization framework to facilitate visual exploration of telehealth data: A case study	2012	**for**	International Cartographic Association Commission on Visualizations and Virtual Environment (ICACVVE); NUTES health center; cancer researchers; policy makers; program mangers; epidemiologist; consumer groups;	NUTES health center;	5	4/1/2015

B Kolko, A Hope, W Brunette, K Saville, W Gerard, M Kawooya, R Nathan	Adapting collaborative radiological practice to low-resource environments	2012	**for**	Ernest Cook Ultrasound Research and Education Institute (ECUREI); University of Washington (UW); midwives in Uganda; Portable Maternal Ultrasound Initiative; women with high risk obstetrical; radiologist; sonographers; radiology residents; nursing and mid wifery educators; maternal and child health advocates; a traditional birth attendant; 52 rural mothers;	midwives in Uganda	5	3/30/2015
O Sohaib, K Kang	Cultural Aspects of Business-to-Consumer (B2C) E-commerce: A Comparative Analysis of Pakistan and Australia	2014	**for**	B2C e-commerce websites in Pakistan and Australia; doctoral student from UTS; online shopping managers; business firm representatives;	users of e-commerce websites in Pakistan and Australia;	4	4/1/2015
JW Rosenboom, C Jacks, K Phyrum, M Roberts, T Baker	Sanitation marketing in Cambodia	2011	**with**	The Royal Government of Cambodia; USAID Cambodia; private importers; manufacturers; distributors; retailers; masons; NGOs; IDEO consultant, Jeff Chapin; IDE Cambodia staff; WSP staff; Ministry of Rural Development staff; World Toilet Organization; Lien Aid; local NGOs; concrete producers; latrine owners and non-latrine owning households; villagers; local government officials at the district commune and village level meetings; neighbors;	people that live in Cambodia; (Rural cambodian households; private sector suppliers)	4	4/1/2015

BP Shrimali, J Luginbuhl, C Malin, R Flournoy, A Siegel	The building blocks collaborative: Advancing a life course approach to health equity through multi-sector collaboration	2014	**by**	Alameda County Public Health Department (ACPHD); local economic development agencies; food access projects; city and county government, community clinics; housing, and parks and recreation; Steering Committee;	Alameda county children	3	4/1/2015
MB Motlhabi, WD Tucker, MB Parker, M Glaser	Improving usability and correctness of a mobile tool to help a deaf person with pharmaceutical instruction	2013	**by end user**	local senior pharmacy; industrial design engineers; students; pharmacists; deaf education specialist; computer scientists;	deaf people in a developing region	3	3/30/2015
R Rege	Designing interactive information access technologies for small scale rural indian farmers	2009	**for**	none	rural Indian farmers	3	4/1/2015
R Rege, S Nagarkar	Krishi-Mitra: case study of a user-centric ICT solution for semi-literate and illiterate farmers in India	2010	**for**	local agricultural experts; local agro-based markets; agricultural experts; local shop keepers; government; fellow interface designers;	semi-literate and illiterate Farmers in India	3	4/1/2015
A Joshi, M de Araujo Novaes, J Machiavelli, S Iyengar, R Vogler, C Johnson, J Zhang, CE Hsu	Designing Human Centered GeoVisualization application–the SanaViz–for telehealth users: A case study	2012	**for**	NUTES Telehealth center at Federal University of Pernambuco, Recife, Brazil; administrator; Computer system analyst; health informatics researcher; health professional; project manager; statistician; UTS review board;	telehealth users in Brazil	3	4/1/2015
J Spencer, D Lilley	The effect of culture on sustainable behaviour in a design context	2012	**for**	translators; government;	citizens of the United Kingdom, India, and Brazil	3	3/30/2015
E Blank, N Tuikong, L Misoi, J Kamano, C Hutchinson, S Kimaiyo, V Fuster, M Were, R Vedanthan	Usability of implementing a tablet-based decision support and integrated record-keeping (DESIRE) tool in the nurse management of hypertension in rural	2013	**for**	Academic Partnership Providing Access to Healthcare (AMPATH); physicians; nurses; government of Kenya;	nurses employed by government in rural Kenya	3	4/1/2015

H Knoche, PRS Rao, J Huang	Human-Centered Design for Development	2012	**with end user**	technical experts from India and Switzerland; Atmospheric research institute; local NGO in Chennakeshava Pura (village in Karnataka): mkrishi;	marginal farmers in India; scientists;	3	4/1/2015
E Johnson, B Kolko, O Salikhbaeva	Boundaries and information: Sidestepping restrictions through Internet conversations	2009	**by end user**	survey firm in Kazakhstan; soviet union; president;	people that use online chats and forums in Central Asia	2	4/1/2015
B Aryana, C Boks, A Navabi	Possibilities for cultural customization of mobile communication devices: the case of IRian mobile users	2011	**by end user**	Original Equipment Manufacturer (OEM); mobile phone marketing managers in Iran; 15 volunteers; mobile communication companies;	Iranian users of mobile communication devices	2	3/30/2015
S Fox, C Le Dantec	Community historians: scaffolding community engagement through culture and heritage	2014	**by end user**	residents of the target community; community residents; community historian; street walkers; drug dealers; police; authorities;	Atlanta Community	2	4/1/2015
M Kam, A Tibuzzi, X Hua	Location-based services for low-income communities in the California Central Valley	2004	**for**	LBS programmers; nonprofit staff members; Central Valley Partnership; Civic Action Network; UC Berkeley faculty and graduate students;	California Central Valley Community	2	3/30/2015
I Hussein, E Seman, M Mahmud	Barriers and drivers of human-centered ICT design: The missing elements in Malaysia	2009	**for**	CEO's; managers; project leaders; IT sales and marketing; senior analyst; system analyst; programmer; executives;	Malaysian HCI practitioners	2	4/1/2015
F Kamoun, N Werghi, M Al Blushi	On the Appropriateness of Incident Management Systems in Developing Countries: A Case from the UAE	2010	**for**	local police department; dispatcher; emergency patrol; responders; call-takers; World Health Organizations; CCR; officer; public safety agencies;	emergency response teams (citizens of one of the "least prosperous" Emirates in the UAE)	2	3/30/2015

Z Fu, X Zhang	Designing for social urban media: creating an integrated framework of social innovation and service design in china	2011	**for**	Chinese designers; parsons the new school for design in NY; Tsing Hua University; taxi drivers;	social media and technology users in China	2	3/30/2015
W Brunette, M Hicks, A Hope, G Ruddy, RE Anderson, B Kolko	Reducing Maternal Mortality: An Ultrasound System for Village Midwives	2011	**for**	pregnant women in Uganda; University of Washington Radiology Department; radiologists and sonographers in the United States; midwives; 4 physicians; husbands; clinical officers; patients; mother-in-law; neonates;	midwives in Uganda	2	4/1/2015
B Kolko, C Putnam, E Rose, E Johnson	Reflection on research methodologies for ubicomp in developing contexts	2011	**for**	Central Asia + Information and Communication Technology (CAICT) project; managers at local NGO internet access points; local researchers; 4 US researchers; 3 Kyrgyzstan researchers; Family and youth in the capital city of Bishkek, Kyrgyzstan, interpreters;	internet users in uzbekistan, kyrgyzstan, and kazakhstan	2	4/1/2015
M Sebillo, G Tortora, G Vitiello, P Di Giovanni, M Romano	A framework for community-oriented mobile interaction design in emerging regions	2013	**for**	The Social Life Networks for the Middle of the Pyramid (SLN4MoP) researchers; Sinhalese	Sri Lankan Farmers	2	4/1/2015

R Vedanthan, JH Kamano, CR Horowitz, D Ascheim, EJ Velazquez, S Kimaiyo, V Fuster	Nurse Management of Hypertension in Rural Western KE: Implementation Research to Optimize Delivery	2014	**for**	Academic Model Providing Access to Healthcare (AMPATH); Icahn School of Medicine at Mount Sinai (New York) and Moi University College of Health Sciences (Kenya) review boards; Moi Teaching and Referral Hospital; Government of Kenya; North American universities and medical centers; Kenyan Ministry and Health facilities; physicians; government of Kenya;	rural clinicians (nurses and clinical officers) in western Kenya	2	3/30/2015
ML Gilliam, SL Martins, E Bartlett, SQ Mistretta, JL Holl	Development and testing of an iOS waiting room “app” for contraceptive counseling in a Title X family planning clinic	2014	**with**	clinicians; clinic staff; University of Chicago programming team; Chicago-based family planning clinic; app testers; patients; clients;	mothers and fathers contemplating contraceptive treatments	2	3/30/2015
NLA Alvarez	Co-created tools for teaching, learning and designing services in Colombia. Facilitating interdisciplinary learning in service design innovation	2012	**with end user**	schools of Design and Management of Los Andes University in Bogota -- Colombia; companies that students work with; low income neighborhoods; Colombian- Asian restaurant; students; professors;	students involved in Innovation workshop	2	3/30/2015
D Löffler, K Lindner, J Hurtienne	Mixing languages': image schema inspired designs for rural Africa	2014	**by**	inexperienced designers (undergraduates); clients of a cooperating solar panel company; Eight German Human-Computer-Systems and Media Communication undergraduates; Rural African dwellers;	electrical energy consumers in rural Kenya	1	3/30/2015
K Pecknold	Dialogue through design: visual communication across the cultural divide	2009	**by end user**	none	cooperative of weavers in a rural village in Rwanda	1	4/1/2015

B Ariyatum, R Holland, P Sirisalee, D Prommin	Identifying Strategic Directions for Design Development of General Hospital Equipment for Thailand	2009	**for**	Medical Devices Laboratory (MDL) of the National Metal and Materials Technology Center (MTEC); National Science and Technology Agency (NSTDA); Thai industries; healthcare practitioners at Thammasat University Hospital; Nurses and nurse assistants (healthcare users); Deputy Director of the Sirindhorn National Medical Rehabilitation Center (SNMRC) or (purchaser); Assistive Technology Center (ASTEC); Healthy Ageing Research Program (HARP); Chulalong University; the Human Centered Design Laboratory, King Mongkut's University of Technology; manufacturers;	Thai healthcare users, purchasers, designers, and manufacturers	1	4/1/2015
Z Ying	Product Design for Low-Income Group Base on User-Centered Design	2010	**for**	landlord;	low-income youth in China	1	4/1/2015
A Zewge, K Weldemariam, S Hailemariam, A Villafiorita, A Susi, M Belachew	On the use of goal-oriented methodology for designing agriculture services in developing countries	2012	**for**	farmers; information service workers; agricultural development agents; agricultural experts; farm input supplier; credit agents; regional office; extension agents;	rural farmers in developing countries	1	4/1/2015
K Asano, K Yamazaki	Observation Analysis Method for Culture Centered Design–Proposal of KH Method–	2013	**for**	students; China Institute of Technology; Tama Art University; Children; Parents;	product designers	1	4/1/2015
A Kavanaugh, A Puckett, D Tatar	Scaffolding Technology for Low Literacy Groups: From Mobile Phone to Desktop PC?	2013	**for**	Literacy Volunteers of the New River Valley (LVNRV) community engagement specialists; adults; janitorial workers; housekeepers;	low socioeconomic status (SES) adults in South Central Appalachia	1	4/1/2015

AE Wood, CA Mattson	A Method for Determining Customer Needs in the Developing World	2014	**for**	resource-poor individuals in developing countries; Student group; NGO fixated on water issues; Water purification experts; residents of Visakhapatnam; Visitors; Women; Husbands; Men who fish; foreigners; Group of children; lower caste people; broo maker (skilled); women who wash clothes; Puno (peru residents);	engineers	1	4/1/2015
A Hope, W Brunette, W Gerard, J Keh, L Schlenke, R Anderson, R Nathan, B Kolko	The Midwife's Assistant: Designing Integrated Learning Tools to Scaffold Ultrasound Practice	2012	**with**	University of Washington Department of Radiology; Ernest Cook Ultrasound Research & Training Institute (ECUREI); sonographers; radiologists; research team; frontline healthcare providers; local voice actor; nurses; ultrasound instructors; traditional birth attendants; health worker (CHW); rural mothers;	midwives in Uganda	1	4/1/2015
R Chaudhri, D Vlachos, G Borriello, K Israel-Ballard, A Coutsoudis, P Reimers, N Perin	Decentralized human milk banking with ODK sensors	2013	**with**	Department of Health in South Africca (SA-DOH); lactating donor mothers; PATH; Human Milk Banking Association of South Africa (HMBASA); faculty at the Nelson mandela School of Medicine at the University of KwaZulu-Natal (UKZN); King Edward Hospital (KEH); milk bank supervisors; milk bank technicians; neonatologist; local engineers; baby; Seattle subjects;	child bearing women in South Africa	1	3/30/2015

S Shahid, E Krahmer	Human-centred Design in the Developing World: Towards designing didactic games for children	2009	**with end user**	non-profit organization in Pakistan; trained designers; local community member; children; parents; 4 designers;	illiterate children in Pakistan	1	4/1/2015
P Cole, J Pinfold, G Ho, M Anda	Examining the methodology of participatory design to create innovative sanitation technologies in rural Malawi	2013	**with end user**	UNICEF Malawi; local builders and villagers; District-level Environmental; District staff members; Health Officers (EHOs); assistant EHOs and health surveillance assistants; construction specialists and householders; CLTS program;	citizens of rural Malawi	1	3/30/2015
N Takeyama	Co-designing with weaving communities in Laos	2014	**by end user**	village people; researchers; academics; textile weavers at Houey Hong Vocational Training Centre for Women; A Craft Initiative; "Design for" team	textile weavers	0	4/1/2015
S Lazem, A Shoa'la, M Elteir, WM Sheta	Designing Low-Cost Technologies to Improve the Quality of Learning and Health Services in Future Egyptian Smart Cities–Three Case Studies	2014	**by end user**	Egyptian citizens; undergraduate students;	Egyptian citizens with a special emphasis on the illiterates and low-literate citizens living in rural areas	0	4/1/2015
J Liu, A Boden, DW Randall, V Wulf	Enriching the distressing reality: social media use by chinese migrant workers	2014	**by end user**	virtual online forums; Q-Zone/Tencent; taxi drivers; female part-time servants; company owner;	Migrant workers in China; sia;	0	4/1/2015
A Campbell, KG Brand	In-context and ecology immersion for resilience: an exploration of the design of a household farming kit	2014	**by end user**	Food and Agricultural Organization of the United Nations (FAO); Balimi Food Security Company (BFSC); Jeffery Hughes; William van Zyl; Soweto Scholars; Bella Martin and Bruce Hanington; Singanapalli Balaram; RITTEL; Meadows; Pirsig; Ian Smillie; Small scale farmers; University of Johannesburg;	farmers in South Africa	0	4/1/2015

CA Le Dantec, S Fox	Strangers at the Gate: Gaining Access, Building Rapport, and Co-Constructing Community-Based Research	2015	**by end user**	director of the neighborhood association; state representative; chairperson of neighborhood planning unit; university president; technical assistant; community cultural arts organization; community historians; Atlanta community planning committee; local policy makers;	African American community near Atlanta	0	4/1/2015
AK Sin, A Ahmad, HB Zaman, R Sulaiman	A wearable device for the elderly: A case study in Malaysia	2014	**for**	elderly from age 58 – 73	elderly (approx 58 – 72) users of technology	0	4/1/2015
R Chhatpar, R Fabricant	Internet Design for Emerging Markets	2014	**for**	Researchers; designers; South Africans Rwandese; Kenyans; Ugandans; Indonesia;	citizens of emerging markets	0	4/1/2015
M Ntinda, H Thinyane, I Sieborger	m-Learning system enhancing mathematical concepts (m-LSEMC): A case study of University of Namibia and Rhodes	2014	**for**	University of Namibia; Extended Study Unit (ESU) at Rhodes University; tutors; lecturers; faculty; mathematics lecturers;	first year students at University of Namibia	0	4/1/2015
D Modi, R Gopalan, S Shah, S Venkatraman, G Desai, S Desai, P Shah	Development and formative evaluation of an innovative mHealth intervention for improving coverage of community-based maternal, newborn and child health …	2015	**for**	Accredited Social Health Activist (ASHA); SEWA Rural; clients: pregnant women, mothers of infants, new born babies, children under age of 2;	ASHAs	0	4/1/2015
H Tawfik, O Anya	Evaluating practice-centered awareness in cross-boundary telehealth decision support systems	2015	**for**	clinicians in rural areas of Nigeria; clinicians in the UK; patients; multi-disciplinary team (MDT);	clinicians in rural Nigeria	0	4/1/2015

R Vedanthan, E Blank, N Tuikong, J Kamano, L Misoi, D Tuilenge, C Hutchinson, D Ascheim, S Kimaiyo, V Fuster, MC Were	Usability and Feasibility of a Tablet-Based Decision-Support and Integrated Record-Keeping (DESIRE) Tool in the Nurse Management of Hypertension in Rural …	2015	**for**	Icahn School of Medicine at Mount Sinai review board; Moi University College of Health Sciences review board; Academic Modeling Providing Access to Healthcare (AMPATH); rural clinicians; physicians; patient rural clinicians; nurses; clinical officers; AMPATH Informatics team; Clinical mentors'; program managers; mobile health developers;	nurse in rural western Kenya	0	3/30/2015
C Catalani, E Green, P Owiti, A Keny, L Diero, A Yeung, D Israelski, P Biondich	A Clinical Decision Support System for Integrating Tuberculosis and HIV Care in KE: A Human-Centered Design Approach	2014	**with**	TB Tech research team; clinician teams; medical superintendents; clinicians; Ministry of Health officials; laboratory mangers; pharmacy managers; medical directors; TB care providers; AMPATH administrators and program managers; data quality workers; community health workers; Moi University; Indian University;	clinicians in Kenya	0	3/30/2015
B Longo	RU There? Cell Phones, Participatory Design, and Intercultural Dialogue	2014	**with**	NGO in Southeast DR Congo; information design graduate students; Women in the Congo (WITC); Tenke Fungurume Mining; internatinal development NGOs; Pact; Rawbank	rural businesswomen and small farmers and artisanal miners in Southeast DR Congo	0	4/1/2015
Y Jeong, S Kim, J Lee	A Design Process based on Field Research: An Adjustable Desk for Children in Rural India	2014	**with end user**	Southern Health Improvement Samity (SHIS); students; parents; teachers; NGO members;	children in rural india	0	4/1/2015
B Aryana, T Clemmensen, C Boks	Users' participation in requirements gathering for smart phones applications in emerging markets	2014	**with end user**	Original Equipment Manufacturer (OEM); Base of the Pyramid (BoP) user group; marketing; facilitator;	first-time smart phone users in Iran and Turkey	0	3/30/2015

A Kumar, S Maskara	Revealing clinicians' experiences towards healthcare software usability using human–centred design approach	2015	**with end user**	healthcare service providers; insurance companies; government; pharmaceutical companies; pharmacy retailers; equipment suppliers; medical managers; patients; practitioners;	clinicians in India	0	4/1/2015

Part 2: IDIN Survey Materials

IDDS Feedback Questions

Used in various IDDS Surveys, 2014-2016

Week 1 Survey

1. What were your favorite moments?

2. What were your least favorite moments?

3. What has surprised you so far?

Logistics, amenities and support		
	Rating [1= Not Good, 5=Great]	**What is working well? What could be improved, and how?**
Housing *(rooms, dormitories, bathrooms)*	1 2 3 4 5	
Food	1 2 3 4 5	
ICT support *(USB modems, etc.)*	1 2 3 4 5	
Health *(Are your health needs being met?)*	1 2 3 4 5	
Quality of instruction *Are the instructors clear? Engaging? Prepared?*	1 2 3 4 5	
Schedule of daily activities *Do the sequence, timing, and amount of activities make sense?*	1 2 3 4 5	

Activities		
	Rating [1= Not Good, 5=Great]	**Was the activity valuable to you? How well was it executed? What could be improved, and how?**
Morning Circle	1 2 3 4 5	
Design Challenge 1 *(Protecting your egg)*	1 2 3 4 5	
Build-Its *Which Build-It did you do?* _____	1 2 3 4 5	
Stakeholder Analysis	1 2 3 4 5	
Observe, Ask, Try *(Field research methods – prepare for community visits)*	1 2 3 4 5	
Community Visit *How did it go? How much did you feel you accomplished?*	1 2 3 4 5	
Problem Framing Trees	1 2 3 4 5	
Design Challenge 2 *(Giving value to waste – your trash bags)*	1 2 3 4 5	

Team and Project		
	Rating [1= Not Good, 5=Great]	**What is working well?** **What could be improved, and how?**
Project selection *How was the selection process?*	1 2 3 4 5	
Preparedness for community visit *(How prepared did you feel?)*	1 2 3 4 5	
Teamwork *How well is your team working together?*	1 2 3 4 5	
Facilitation *How well has your facilitator supported your team?*	1 2 3 4 5	

Overall, how do you feel about your project so far?

Overall, how are you feeling about IDDS so far?

Week 2 Survey

Part 1: Logistics and support in the communities		
	Rating [1= Not Good, 5=Great]	**What worked well?** **What could be improved, and how?**
Housing	1 2 3 4 5	
Food	1 2 3 4 5	
Language Support	1 2 3 4 5	
Transport	1 2 3 4 5	

Part 2: Community reception		
	Rating [1= Not Good, 5=Great]	**Please comment further on your interactions with the community.**
Welcome *How welcome did you feel in the community?*	1 2 3 4 5	
Interest *How interested were community members in IDDS/your project?*	1 2 3 4 5	
Part 3: Team and Project		
	Rating [1= Not Good, 5=Great]	**Please comment on your team's progress, challenges & successes.**
Preparedness *How prepared did you feel for the visit?*	1 2 3 4 5	
Productivity *How much did you feel you accomplished?*	1 2 3 4 5	
Teamwork *How well is your team working together?*	1 2 3 4 5	
Facilitation *How well has your facilitator supported your team?*	1 2 3 4 5	

Part 4: Activities		
	Rating [1= Not Good, 5=Great]	**What worked well?** **What could be improved, and how?**
CCB/Build-It	1 2 3 4 5	
Problem Framing Trees	1 2 3 4 5	

Sketch Modeling	1 2 3 4 5	
Community Presentations	1 2 3 4 5	
Design review (VETA)	1 2 3 4 5	
Value proposition	1 2 3 4 5	

1. What were your favorite parts about the community visit?

2. What were your least favorite parts about the community visit? (parts you did NOT like)

3. What were some important lessons you learned this week?

4. Overall, how did you feel about your experience in the community?

Week 3 Survey

Part 1: Team Dynamics		
	Rating [1= Not Good, 5=Great]	**What are your team's strengths and weaknesses? Overall, how are you feeling about working in your team?**
Participation *Do all team members contribute equally? Does everyone have a meaningful role? Is everyone's voice heard?*	1 2 3 4 5	
Communication *How well do team members communicate with each other?*	1 2 3 4 5	
Conflict *How well does the team handle disagreements?*	1 2 3 4 5	

Part 2: Design Facilitator: _____		
	Rating [1= Not Good, 5=Great]	**Please comment further on your design facilitator's support throughout IDDS. What has worked well, and what could be improved?**
Knowledge *How would you rate your DF's knowledge about design?*	1 2 3 4 5	
Teaching *How well has your DF taught the tools of the design process?*	1 2 3 4 5	
Facilitation *How well has your DF supported your team through the design process?*	1 2 3 4 5	

Part 3: Project		
	Rating [1= Not Good, 5=Great]	**Please comment on your project's successes, challenges, next steps and future potential.**

Progress *How much has your team accomplished since the first visit?*	1 2 3 4 5	
Community Interest *How much interested has the community shown in your project?*	1 2 3 4 5	
Potential for Continuity *How likely is it that your project will continue after IDDS?*	1 2 3 4 5	
Future Involvement *At this time, how likely are you to stay involved with this project after IDDS?*	1 2 3 4 5	

Post-Survey

Part 4: Improving IDDS

8. Please help us improve the **teaching**, **curriculum** and **learning** at IDDS. What worked well, and what could be improved? What do you think was missing? What could have been covered more in depth? Are there things that could be removed? *(You may choose to comment on structure, topics covered, instructors, design notebook, specific sessions, etc.)*

9. Your **projects** are the centerpiece of IDDS and make up the largest portion of your experience. In your team's project experience, what worked well, and what could be improved? How could IDDS better support your project development? *(You may choose to comment on project framing/selection, facilitation, etc.)*

10. The **communities** are one the most important parts of IDDS, and we are always working to make community engagement more meaningful and impactful. In your experience interacting with a community, what worked well, and what could be improved?

IDDS Learning Questions

Used in various IDDS Surveys, 2014-2016

Open-Ended Format, Quiz Format, and Self-Assessment Format

Open-Ended Format

Asked in Post-Survey:

1. Please share your thoughts on the **value** of IDDS. What aspects of the IDDS experience have been most valuable to you, and why?

2. What **skills** or **knowledge** do you feel you have gained or developed over the past month as a result of participating in IDDS? Please be as specific as possible.

3. Have your **attitudes** or **perspectives** changed in any way over the past month as a result of participating in IDDS? Please explain.

Asked in Mid-Survey:

What were some important **lessons** you learned this week?

or

What was the most important **lesson** you learned this week?

"Quiz" Format (Asked in Pre-Survey and Post-Survey)

(I do like these questions as a temperature check or an activity within a session, but as I mentioned, more test-literate people end up getting them right both in the pre and post survey, and fewer test-literate people succeed on these in either survey.)

1. A team of participants is getting ready to go for their first community visit. While still in Arusha, the summit organizers told them women in that community worked long hours performing household duties, which left little time for income generating activities**.**

What should the team do before their visit?

(Select one option.)

☐ Build a working prototype of a time-saving device to test out with the women of the community.

☐ Prepare a few designs for time-saving devices to propose to the women of the community.

☐ Prepare strategies to ask questions, observe, and better understand the problems the women are facing. **(correct answer)**

☐ Map out the problem to determine its root causes before they arrive in the village.

2. After their community visit and several days of brainstorming, modeling and experimenting, the team decide on a prototype of a pedal-powered washing machine. They are happy with how the design is coming along, but they are worried that it will be too expensive for their customers to buy.

What are some ways that they could make their design more affordable?

(Correct if they can name at least one way; we've also analyzed the number/variety of ways mentioned in the pre- vs. post- surveys.)

3. The team brought their prototype of a pedal-powered washing machine back to the community. When the women tested it out, they had a difficult time pedaling in their skirts.

Their prototype suffered from a challenge of:

(Select one option.)

☐ Affordability
☐ Manufacturability
☐ Usability **(correct answer)**

☐ Sustainability

4. The team improved their prototype based on the feedback, and they began to think about how it might be distributed on a wider scale in the future. One team member proposes that they create a central factory to manufacture the machine and ship it out to thousands of local communities. Another team member argues that it would be better to teach thousands of people to build the washing machine locally.

What are some of the disadvantages to producing in a central facility?

(Select all that apply – can be more than one.)

☐ The resulting product will be less well adapted to the local context. **(correct answer)**
☐ There is less certainty that the product will be of good quality.
☐ Distribution costs will be higher. **(correct answer)**
☐ It will get more and more expensive to make each additional product.

Self-Assessment Format (Asked in Post-Survey)

(You can also ask these questions in a pre-survey to understand participants' starting points and priorities, but I wouldn't recommend calculating the change in rating between pre and pre-survey for the reasons we discussed – it hasn't worked well for us.)

1. Before IDDS, how comfortable did you feel doing the following activities?

2. Now that IDDS is over, how comfortable do you feel doing the following activities?

5 = Very comfortable
4 = Somewhat comfortable
3 = Neutral
2 = Not very comfortable
1 = Not at all comfortable

Before	Now	
____	____	Making things with wood and metal
____	____	Making electronic devices
____	____	Making things from found or recycled materials
____	____	Making ICT-based tools
____	____	Using the design process to solve community challenges
____	____	Gathering input and feedback from those affected by a problem
____	____	Working in diverse teams
____	____	Teaching my skills to others
____	____	Expressing my ideas to a group of people
____	____	Empathizing with the viewpoints of others
____	____	Designing and planning a business
____	____	Launching and running a business

Alternative:

Now that IDDS is over, how much more confident do you feel performing the following activities?

"A lot more confident"
"More confident"
"About the same"
"Less confident"
"A lot less confident"

Optional additions:

Which, if any, of the above skills do you feel has changed the most?

Which of the above skills do you believe is most valuable(/relevant) to you?

IDDS Outcome Questions

Used in various IDDS Surveys, 2014-2016

(Selected questions from 12 month post-survey)

Looking back on IDDS Zero Waste, what part of the experience affected you the most? Which sessions (if any) have stuck with you?

Last June, we asked you about how your IDDS experience might affect your goals and actions this year. Since the summit ended, which of the following have you done?

☐ Worked on an innovation or venture
- ☐ Worked on an innovation or venture related to my IDDS project
- ☐ Worked on an innovation or venture that existed before IDDS Zero Waste
- ☐ Started a new innovation or venture

☐ Started a new job or internship in the design, development or waste management field
☐ Brought new collaborative design techniques into my current job or role
☐ Got involved with a local community of designers or IDDS alumni where I live
☐ Taught what I have learned about design, co-creation and development to others
☐ Engaged in further study or research about design and development
☐ Other: _____

Please elaborate below! (1-3 sentences)

IDDS Connections

Which IDDS alumni have you kept in touch with? Please list up to five IDIN Network members you interacted with <u>most</u> in the last 10 months.

Examples:
Héctor García (working together on Zero Waste Park)
Omar Crespo (meeting regularly at IDDS Guatemala chapter meetings)

Person 1

Person 2

Person 3

Person 4

Person 5

IDIN Engagement

How have you gotten involved with IDIN over the last 12 months?

☐ I am an IDDS organizer this year.
☐ I have spent time at an IDIN innovation center.
☐ I have been involved with an IDIN local chapter.
☐ I have helped another IDIN Network member with their project.
☐ I have volunteered for other IDIN activities or committees.
☐ I have connected other IDIN Network members with information, resources, and/or people.
☐ I have organized a social gathering of IDIN Network members.
☐ I have kept in touch with IDIN through the newsletter, IDIN.org, Facebook, or Twitter.
☐ Other (please describe): _____
☐ I have not engaged with IDIN in the last 12 months.

Please elaborate below! (1-3 sentences)

-or-

If you have not been involved with IDIN this year, why not? What might make it easier or more appealing for you to get involved with IDIN?

Overall, has it been valuable to you to be a member of the IDIN Network? If so, what aspect has been <u>most</u> valuable to you?