USING THEDESIGNEXCHANGE AS A KNOWLEDGE PLATFORM FOR HUMAN-CENTERED DESIGN-DRIVEN GLOBAL DEVELOPMENT

Kramer, Julia; Poreh, Danielle; Agogino, Alice
UC Berkeley, United States of America

Abstract

Human-centered design, for its value in allowing design practitioners to deeply engage with and understand the manifold needs of their end-users, is often invoked to tackle challenges of poverty and development around the world. TheDesignExchange is the largest comprehensive database of human-centered design methods and has been built to support designers working in a broad range of project and topic areas. Given the burgeoning interest in leveraging human-centered design methods to address challenges in resource-limited settings, theDesignExchange has begun building out case studies to support a network of designers around the world in addressing complex challenges of poverty and development using a human-centered design process.

Keywords: Design methods, Design methodology, Case study, Global development, theDesignExchange

Contact:
Julia Kramer
UC Berkeley
Mechanical Engineering
United States of America
j.kramer@berkeley.edu

Please cite this paper as:
Surnames, Initials: *Title of paper*. In: Proceedings of the 21st International Conference on Engineering Design (ICED17), Vol. 1: Resource-Sensitive Design | Design Research Applications and Case Studies, Vancouver, Canada, 21.-25.08.2017.

1 INTRODUCTION

Human-centered design is a cross-disciplinary approach where designers develop a deep understanding of their stakeholders and use these insights to generate ideas, iteratively prototype, and effectively implement. Design methods, conceived of in the 1960s, provide a structure to the fuzzy and open-ended human-centered design process, yet design methods are underutilized in practice, due in part to a lack of knowledge of their existence and utility. *TheDesignExchange* seeks to make these design methods more accessible to the general public by providing an online repository of design methods. Recently, many organizations have begun to leverage human-centered design methods to address problems of poverty and development around the world. Therefore, in order to support designers in finding design methods appropriate for projects of global development, we have begun creating case studies that explore how design methods are used in a global development and resource-limited contexts (Fuge and Agogino, 2015). We house these case studies in *TheDesignExchange*, a comprehensive database of human-centered design methods and case studies to support designers working in a broad range of project and topic areas (Roschuni, Agogino and Beckman, 2011). By providing contextual examples of design methods in practice, we hope to support designers address complex development challenges through a human-centered design process.

2 BACKGROUND

While the field of design processes and activities has significantly evolved, both in academia and industry, there remains no single, comprehensive collection of design methodologies available for practitioners. This section describes the history of design processes and relevant efforts to categorize design thinking methods (Dym et al., 2005; Brown, 2008).

The study of design methods was introduced during the first "Conference on Systematic and Intuitive Methods in Engineering, Industrial Design, Architecture and Communications" in 1962 (Jones and Thornley, 1962). Since then, the academic inquiries and real-world practices of design research and processes have significantly evolved. Richard Buchanan (2001) defines "design" as:

> "[T]he human power of conceiving, planning, and making products that serve human beings in the accomplishment of their individual and collective purposes."

More recently, popular terms such as "design thinking" and "human-centered design" have emerged in an effort to describe the holistic, interdisciplinary nature of design. Tim Brown, CEO of the global design consultancy IDEO, defines design thinking as ("About IDEO," 2016):

> "[A] human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success."

Many attempts have been made to capture and define the multidisciplinary and abstract nature of design processes and activities. Asimow (1962), for example, defines the design process as simply a series of analysis, synthesis and evaluation. Other definitions include Ulrich and Eppinger's textbook (2016) describing the steps of new product development, and Charles Owen's (2001) model of depicting the design process as having:

> "[R]ecognizable phases… nearly always begin with analytic phases of search and understanding, and end with synthetic phases of experimentation and invention."

In an effort to consolidate the numerous and ranging definitions of design processes and activities, Roschuni (2012), organized and evaluated 82 different design processes into a general process model. Roschuni and *theDesignExchange* team later refined the design process into five key groups of design methods: Research, Analyze, Ideate, Build, and Communicate. Each of these groups represents the common activities and goals performed throughout the design process.

Despite the significant evolution of design thinking, attempts to organize design methods remains insufficient. IDEO created the Human-Centered Design (HCD) toolkit (2009), containing nineteen design methods organized into "Hear," "Create," and "Deliver". The LUMA Institute (2014) developed the LUMA System of Innovating for People, a collection of thirty-six design methods into three "key practice" areas. Other works include Service Design Tools (2009) and ParticipationCompass (2014), which focus on methods specific to service design and public engagement, respectively. However, these do not capture the broad nature of design thinking methods. *TheDesignExchange* (Roschuni, Agogino and Beckman, 2011) was the first attempt at a comprehensive library of design methods, including over 300 methods applicable to a range of disciplines.

Today, *theDesignExchange* is a web-based platform aimed to facilitate the capture, analysis and widespread use of design methods. Since the initial launch in 2012, the application has undergone many rounds of user testing and iteration. User testing revealed that simply listing design methods did not reflect their use in application. To capture how design methods are used in practice, case studies were introduced to the web portal. The current beta prototype (www.thedesignexchange.org) includes over 300 methods and case studies.

2.1 Design methods

Design methods are rational procedures that provide a specific way to proceed in a process. A method is general in that it can be used to solve more than one specific problem, and is observable in its use (Roozenberg and Eekels, 1995). Such methods can provide structure to fuzzy, open-ended processes, and support designers in accomplishing goals that have systematically been linked to successful outcomes in design practices (Jagtap, Warell, Hiort, Motte, and Larsson, 2014). However, in practice, design methodologies are underutilized. Companies remain unaware of the range of methodologies or may focus on industry-specific methods (Gericke, Kramer and Roschuni, 2016). Additionally, methods are not taught through an interdisciplinary lens and are not perceived to be contextually relevant.

2.2 Design case studies

According to Kardos and Smith (1979), an engineering "case study" is:

> "[A]n account of an engineering activity, event or problem containing some of the background and complexities actually encountered by an engineer. A case is used in engineering courses to enhance learning about engineering principles and practices."

A good case study includes four key characteristics (Kardos and Smith, 1979):

1. Is taken from real life (a necessity)
2. Consists of one or more parts, each usually ending with problems and/or points for discussion
3. Includes sufficient data for the reader to treat problems and issues
4. Is believable (contains the setting, personalities, sequence of events, problems and conflicts)

Case studies provide a medium to learn through contextual examples and therefore, can be utilized to better understand how practitioners utilize design methods in practice. By incorporating case studies on *theDesignExchange*, designers can leverage design methods more effectively into their projects.

2.3 Design for global development

"Development" has an ambiguous definition, with various interpretations ranging from the specific and positive to the vague and cautionary. Alan Thomas (1999) defines development as "a historical change process, deliberate efforts aimed at progress, [and] an orientation towards progressive change."
Taking a more critical and skeptical approach, Tariq Banuri (1990) views development as "a license for imperial intervention."

2.3.1 History

The history of design, as a general discipline, in development is closely tied to the history of development itself (Clarke, 2015). James Fathers (2004) (with more recent support from Krista Donaldson (2009)) posit that design first entered into a context of international development following World War II, with the advent of the Marshall Plan. Fathers provides three major waves of interest in design for development:

1. Reconstruction (1940s to 1960s)
2. Alternative Actions (1960s to 1980s)
3. Mixed Response (1980s to present)

In brief, the **Reconstruction** wave began with the Marshall Plan and was marked by post-war aid and reconstruction efforts, including the rebuilding of physical spaces, economies, and markets. In this sense, "aid" is generally understood as the giving of material relief.
The **Alternative Actions** wave was eponymously characterized by alternative approaches to aid. Papanek's *Design for the Real World* (1984), appropriate technologies, design for the underserved, and socially responsible design fall into this wave of design for development. The 1979 Ahmedabad Congress, at the tail end of the Alternative Actions wave, signaled a turning point in the conversation around "design." During the Ahmedabad Conference, Clarke (2015) points out:

> "ICSID [International Council of Societies of Industrial Design], the leading professional body [of industrial design], began to question the overtly commercial role of the designer, addressing instead design as a tool for social change within a humanist paradigm that crossed both post-industrial and so-called 'developing nations'."

Thus, the Alternative Actions wave of design for development can be seen as the inception of what would later become known as human-centered design.

The **Mixed Response** wave was marked by increasing academic interest and increasing globalization. According to Donaldson (2009), the Mixed Response wave was catalyzed by the globalization of the late 1990s, which was brought on by the advent of new connective technologies. Ramirez Jr. (2011) echoes the large amount of approaches interested in "design with a social conscience," including green design, universal (accessible) design, and corporate social responsibility campaigns.

2.3.2 Critiques

Design for development efforts retain a dualistic understanding of design, where those who are designed *for* are separated from those who *do* the designing. This dualism is implicitly hierarchical and the elite designers are presumed to have more capacity to carry out a design than those for whom they design (Clarke, 2015).

Participatory design and co-design (Perez et al., 2015) attempt to address this critique by directly involving end-users in a collaborative design process, but in practice, these approaches still tend to be led by outside designers. Even in the cases where designers and users work to "learn as one" (Harder, Burford, and Hoover, 2013) and thus erase the dichotomy between them, the design process is still likely initiated by the designer. The users do not tend to be afforded the agency to choose when to start a participatory design process; they are free to opt out, but not to opt in.

Furthermore, the dualistic understanding of design for development is problematic in the way that it individualizes poverty and "underdevelopment." By only focusing on humans as the vessel for understanding a design context, a designer is blind to the broader social dynamics that may be at play (Janzer and Weinstein, 2014), including the political environment, the local and global governance, and the history of disenfranchisement. Dualistic design for development ignores how the designers themselves are inextricably linked to those they design with. Janzer and Weinstein (2014) provide three critical shortcomings of design for development:

1. Research on the context of the problem is under-emphasized and over-simplified
2. Prior to implementation, there is little emphasis on ensuring solutions are appropriate or contextualized
3. The designer and their creative freedom are prioritized over the end-user's empowerment or worldview

In particular, Janzer and Weinstein (2014) point out that approaches to social design tend to lack rigorous evaluation. DiRusso (2016) and Donaldson (2009) echo this lack of evaluation, and discuss how the haphazard and rapid rise of design in development has outpaced the knowledge of how to apply an appropriate design approach. Janzer and Weinstein (2014), DiRusso (2016), and Donaldson (2009) all call for more rigorous efforts to understand how design is employed in development, why particular approaches are appropriate for particular applications, and how design methodologies can be effectively applied to meet the presumed goals of design for development.

2.3.3 Summary of challenges in design for global development

Successful engineering feats of the past have largely been made by and designed for what is sometimes referred to as the "Global North" (National Academy of Engineers, 2008; Polak, 2008). As the challenges plaguing our world grow increasingly complex and seemingly intractable, engineers and designers are increasingly being called upon to bring their technical expertise into the global problem-solving realm.

Levine, Agogino and Lesniewski (2015) discuss several challenges faced in development:

1. The "obvious constraint" of poverty
2. "Institutional voids" (citing Khanna, Palepu, and Bullock, 2010)
3. Lack of information in markets for capital, labor, supplies, and distribution
4. Lack of credible ways to certify quality or trustworthy "aggregators and market-makers that facilitate transactions" (i.e., those who work to regulate and oversee work done in development)
5. Pervasive presence of gender inequality or ethnic discrimination

To address these challenges, we must figure out how to best tap into the large and talented workforce of engineers and designers around the world. How can we support engineers and designers around the world, not just in the Global North, to work on addressing these challenges? Moreover, how can we adapt and apply human-centered design and design thinking frameworks to address global challenges? These questions guide the development of *theDesignExchange* as a knowledge platform to facilitate the sharing and education of global development design practices.

3 *THEDESIGNEXCHANGE* AS A PLATFORM FOR ADDRESSING GLOBAL DEVELOPMENT CHALLENGES

Human-centered design and design thinking offer useful frameworks for thinking through the contextual factors of global challenges and translating an understanding of a challenge into an actionable design outcome. Yet, there is a lack of instruction on how to best account for context (a holistic understanding of resource-constraints, cultural differences, and technological deficiencies) in a given design challenge. By providing a large swath of design methods and case studies particularly focused on design for development, our goal is to build *theDesignExchange* into a global knowledge platform to support innovators around the world in addressing complex development challenges.

3.1 Design methods for global development

TheDesignExchange methods are applicable to a broad range of disciplines. Within this comprehensive database, certain methods are particularly suitable for use in the context of design for development. In addition to design methods that are highly useful in any setting (e.g., Longitudinal Study, Participant Observation, 1:1 Interview, Usability Testing, and Personas), *theDesignExchange* also includes methods that are particularly useful for development (e.g., Cultural Probes, Community Based Participatory Research, and Participatory Co-Design Workshop).

On the portal, the content of each design method is organized under three main tabs: Overview, Instructions, and Resources. Within each tab, there are a series of subcategories that further explain the different aspects of the particular method (Figure 1). The goal is to provide the reader with enough information to deeply understand the relevant aspects of a method needed for its use in practice.

Overview Tab	Instructions Tab	Resources Tab
1. Method Name **2. Synonyms** **3. Image** **4. Video** **5. Summary** *A brief, two-line description of the method* **6. Related Methods** *Used to cross-list and link methods similar to each other* **7. Usage** *This is a description of how and when the method should be used in a design process or a particular context.* **8. Benefits** *This is a description of the particular benefits this method offers.* **9. Limitations/Risks** *This is a description of the method's shortcomings.* **10. Skills** *This lists the skills that might be necessary or useful for conducting the method.*	**1. Instructions** *This provides general but detailed descriptions about how to actually carry out the method* **2. Key Challenges** *This section discusses what are the key challenges of using this method. What are common stumbling blocks that design practitioners face in using this method?* **2. Tips & Best Practices** *This section provides a list of suggestions for how to best use the method.*	**1. Online Tools and Resources** *These are tools available online to facilitate the use of the method.* **2. History** *This section discusses the historical inception and use of the method.* **3. Critiques** *This section discusses the critical analyses and assessments of the method.* **4. Additional Readings** *This section provides further resources that provide more information on the method than is presented on theDesignExchange for the method.* **5. References** *This section lists the sources used to develop the content on theDesignExchange for the method.*

Figure 1. Outline of content provided for each design method on theDesignExchange site

3.2 Case studies characterized as design for global development

We envision *theDesignExchange*, and the case studies on it, being accessible to all with an Internet connection. A user can log onto the site, explore the case studies, and seek either general inspiration or specific tools for use in their design work. While there are many challenges associated with online learning platforms, we are encouraged by the potential for *theDesignExchange* to reach marginalized or rural areas that lack traditional educational infrastructures (Andersson and Grönlund, 2009).

3.2.1 Assembling a dataset of case studies

We began with a systematic literature review of human-centered design for development to serve as an initial dataset of design for development case studies. We chose to begin with a focus on human-centered design given its burgeoning body of work, thanks in large part to its popularization by the design firm IDEO (2009). In the future, we can replicate this search procedure by searching over a more inclusive set of design keywords, including "design thinking," "user-centered design," etc.

To assemble this set of papers, we first created a list of keywords to comprehensively cover the set of publications related to human-centered design for development without including extraneous papers: "human-centered design" plus "developing countries", "developing economies", "developing world", "global development", "global inequality", "global poverty", "international development", "low-income", "low-resource", "poverty", "resource-limited", and "third world".

Using the Publish or Perish software (Harzing, 2007) to retrieve citation data from a Google Scholar search, we searched over these 12 keyword pairs and found 1441 papers. We chose to use Google Scholar over other databases because of its free access to articles, its wide reach in the academic community, and its ability to allow for others to replicate our work in the future. This dataset of papers was narrowed down through a series of systematic deselections to favor impactful peer-reviewed papers in which the authors engaged in the case study (Gordon et al., 2017).

After deselecting all papers that we considered to be non-representative of our intended dataset, we obtained a set of archival peer-reviewed papers written in English that were practical examples of researchers engaging in a human-centered design for development approach.

Next, we considered the "focus area" of each paper in our set. To create a set of focus areas that the papers might be engaged in, we first considered the goals and areas of work of four organizations and initiatives: the United States Agency for International Development (USAID) ("What We Do," USAID, n.d.), the United Kingdom's Department for International Development (DFID) ("Policies," Gov.UK, n.d.), the Sustainable Development Goals (SDG) proposed in 2015 by the United Nations ("Sustainable Development Goals," United Nations, 2015), and the Millennium Development Goals (MDG) proposed in 2000 by the United Nations ("Millennium Development Goals," United Nations, 2000). We then used an open card-sorting exercise (a method often used in usability research ("Card Sorting," UsabilityFirst, n.d.), applicable in design research as well (Roschuni, Kramer, and Agogino, 2015)), to group the goals and/or areas of work of these entities. The focus areas we found include: 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.

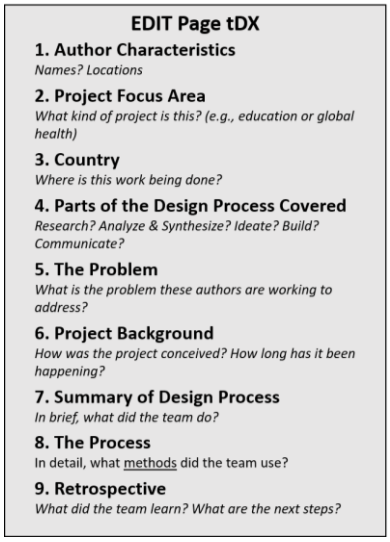
We then tagged each paper in the dataset according to the focus area(s) in which they worked. We also extracted information from each paper in the following categories:

- **Author information**: country where the authors were located at the time of publication (identified by the location of their affiliated institution)
- **Country**: location where the work presented in the paper was being done
- **Parts of the design process covered**: acknowledgment of whether or not the work presented in the paper engaged in Research, Analysis, Ideation, Building, and/or Communication
- **Design Methods**: list of the methods used in conducting the work presented in each paper.

We extracted design methods from the papers in the dataset using a modified grounded-theory approach (Cho and Lee, 2014; Strauss and Corbin, 1994). We analyzed each paper for activities that the authors explicitly mentioned in their papers as being used to further their design progress.

3.2.2 Turning academic papers into accessible narratives

To discover the content that researchers may find particularly useful in a case study, we conducted an informal survey of design practitioners, most of whom reside in the San Francisco Bay Area. The respondents revealed that case study content is most significant when the methods used are specific to the context of the research, rather than simply linking methods to case studies. These findings informed the development of three different versions of case study templates. The aim of each version was to capture the methods used within different phases of a project in the form of a narrative. Three team members wrote the same case study according to the three different templates. A double review process was utilized to evaluate the aspects of each version that best targeted the correct information. Iterations to the templates were made to reflect these findings. Ultimately, a finalized case study template was developed from the feedback of the three initial templates (Figure 2).



EDIT Page tDX

1. Author Characteristics
Names? Locations

2. Project Focus Area
What kind of project is this? (e.g., education or global health)

3. Country
Where is this work being done?

4. Parts of the Design Process Covered
Research? Analyze & Synthesize? Ideate? Build? Communicate?

5. The Problem
What is the problem these authors are working to address?

6. Project Background
How was the project conceived? How long has it been happening?

7. Summary of Design Process
In brief, what did the team do?

8. The Process
In detail, what methods did the team use?

9. Retrospective
What did the team learn? What are the next steps?

Figure 2. Template used to guide the creation of case studies for theDesignExchange site

Throughout the course of the semester, 59 of the 83 case studies characterized as design for development were written in the finalized template format and published in draft form on the web portal. To ensure that the correct information was being captured, each case study was reviewed and approved by a different team member. Finally, prior to publicly publishing the case study on the site, we reached out to the original authors who then authorized the public use of this content. After this two-step approval process, we published the case study on *theDesignExchange*. We are still awaiting authorization from most of the authors to publicly publish these case studies.

3.3 Matching design methods to design case studies

One hundred and nineteen unique methods were employed 431 times in the papers in the dataset. Several of the methods mentioned had not previously been included on *theDesignExchange* site. Figure 3 below shows the methods mentioned in the papers.

Figure 3. All of the design methods mentioned in the papers in the dataset; the larger the font, the more often the method was mentioned.

Figure 3 shows that interviews, surveys, and observations were the most frequently used methods. Interviews were the most popular method, mentioned 58 times. Surveys were mentioned 31 times while observations were mentioned 27 times. Sixty-one methods were mentioned only one time.

Notably, the design methods mentioned in this dataset are not unique to design for development challenges. In fact, interviews, observations, and surveys are all very common methods of human-centered design and research in general. This fact highlights one of the key advantages of the case studies on *theDesignExchange*: designers need a way to understand how common methods are contextualized for specific design projects. For example, in a design for development scenario, a designer may face challenges observing because they are more likely to be faced with an overload of unfamiliar instances to observe and analyze. With interviews, a designer might have a more difficult time communicating with their interviewees because of language and cultural barriers. For surveys, a designer might have to hire on-the-ground enumerators to go door-to-door because online surveys are not accessible to everyone. Case studies provide a useful outlet for designers to reflect upon how they dealt with these and other challenges, therefore allowing other designers for development the chance to learn.

Figure 4 below presents an example of one design for development case study that has been developed and uploaded to *theDesignExchange.* The left sidebar shows the focus area, the country of work, the authors, and the parts of the design process that the case study discusses. Each case study is tagged with the design methods that it uses.

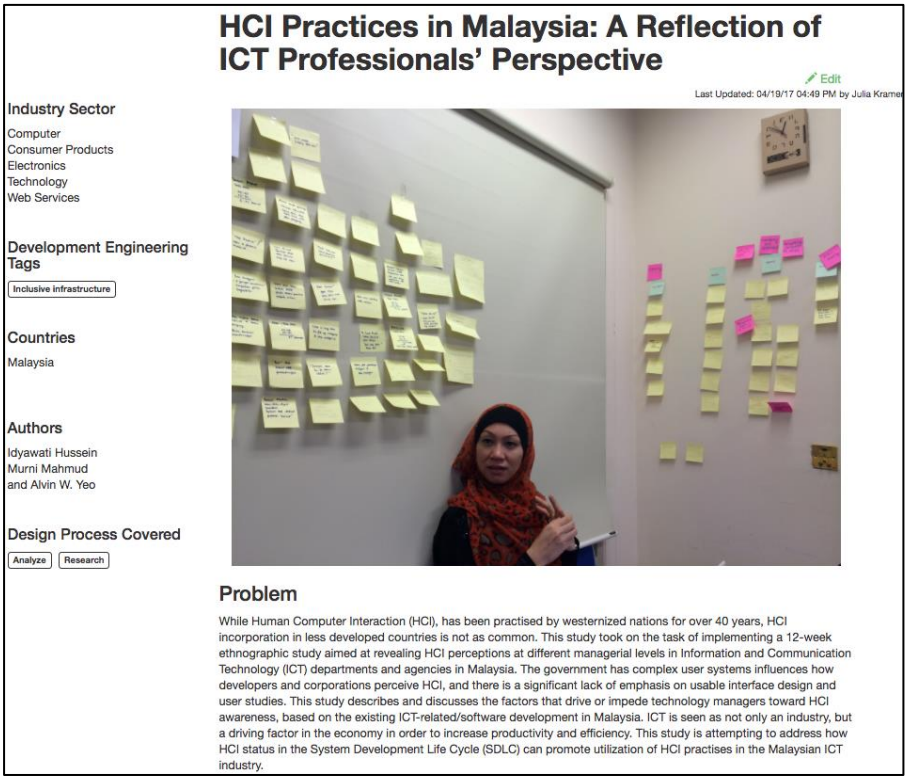


Figure 4. An example case study of global development design currently available on theDesignExchange (https://www.thedesignexchange.org/case_studies/201)

4 LIMITATIONS AND FUTURE WORK

This work does not inherently address the critiques of design being a technocentric approach to addressing fundamentally political challenges. Design thinking, as a mindset, does provide practitioners with the framework to think of varying contextual factors, including policy, history, and individuals, but these systems are not often invoked in design thinking methods. Along with building out our database of design methods and case studies, we will need to particularly focus on curating a set of methods and case studies that provide information on how to think systemically, not just technically. To do this, we can start by looking at participatory design toolkits and draw inspiration from outside the design world, including the Peace Corps Peace Corps PACA (Participatory Analysis for Community Action) toolkit (2007).

The short-term goal of *theDesignExchange* is to continue building a robust library of case studies and relevant methods from the existing dataset. All 83 case studies and relevant method descriptions will be written, authorized, and updated on *theDesignExchange*. Alongside these development efforts, improvements to the website infrastructure, including fixing bugs/glitches and user experience will be implemented. Ethnographic research methods, such as user surveys will be conducted to inform the changes to the layout and design of the web platform. Additionally, the needs of the community will be assessed with the goal of identifying possible business opportunities for *theDesignExchange*.

The mid-term goals are threefold: 1) gather more case studies from the existing design for development community, 2) find case studies in other contextual areas to create a more diverse database, and 3) create a business model to ensure financial stability. We will send a concise but comprehensive survey to design for development community members to understand what they value in a design for development knowledge platform. Current compendiums of design solutions include the Technology Exchange Lab (TEL), Global Innovation Exchange, and ASME Engineering for Change Solutions Library. While these collections contain valuable information pertaining to design for development, there is currently no database for process-oriented case studies. This presents an opportunity for partnerships and sharing of knowledge amongst the design for development community. The goal of *theDesignExchange* is therefore to partner with such organizations in order to collect more relevant case studies on the site, as well as engage more members of the design community. To supplement the library of case studies on *theDesignExchange*, case studies from other contextual areas, such as Design for Sustainability and Universal Design, will be collected and uploaded to the web portal. As we build out this portfolio of case studies, we will engage in validation studies to understand how users engage with the content on *theDesignExchange.*

Alongside the content growth and continued development of the site itself, a comprehensive sustainability model for *theDesignExchange* is being developed. The goal is to ensure that *theDesignExchange* remains available for designers around the world now and in the future.

REFERENCES

About IDEO. (2016), Retrieved October 4, 2016, from https://www.ideo.com/about/

Andersson, A. S., and Grönlund, Å. (2009), "A conceptual framework for e-learning in developing countries: A critical review of research challenges". *The Electronic Journal of Information Systems in Developing Countries*, *38*.

Asimow, M. (1962), *Introduction to Design.* Englewood Clis, NJ: Prentice-Hall.

Banuri, T. (1990), "Modernization and its discontents: a cultural perspective on theories of development". In *Dominating Knowledge: Development, Culture, and Resistance*. http://doi.org/10.1093/acprof

Brown, T. (2008), Design Thinking, *Harvard Business Review*, **86** (6), pp. 84–92.

Buchanan, R. (2001), "Design Research and the New Learning". *Design Issues*, 17(4), 3–23.

Card Sorting. (n.d.), Retrieved October 4, 2016, from http://www.usabilityfirst.com/usability-methods/card-sorting/

Cho, J. Y., and Lee, E. (2014), "Reducing Confusion about Grounded Theory and Qualitative Content Analysis : Similarities and Differences". *The Qualitative Report*, 19(2003), 1–20.

Clarke, A. (2015), "Design for Development, ICSID and UNIDO: The Anthropological Turn" In *1970s Design. Journal of Design History*, epv029. http://doi.org/10.1093/jdh/epv029

DiRusso, S. (2016), *Understanding the behaviour of design thinking in complex environments* A thesis submitted for the degree of Doctor of Philosophy.

Donaldson, K. (2009), "The Future of Design for Development: Three Questions". *Information Technologies and International Development*, 5(4), 97–100.

Dym, C.L. Agogino, A.M., Eris,O., Frey, D.D., and Leifer, L.J. (2005), "Engineering Design Thinking, Teaching and Learning", *Journal of Engineering Education*, **94** (1), pp. 103-120.

Fathers, J.W.R. (2004), "The role of design in development since 1945". *Proceedings of the Gregynog Development Colloquium*.

Fuge, M. and A.M. Agogino (2015), "Pattern Analysis of IDEO's Human-Centered Design Methods in Developing Regions", *ASME Journal of Mechanical Design's special issue on User Needs and Preferences*, **137** (7), MD-14-1571.

Gericke, K., Kramer, J., and Roschuni, C. (2016), "An exploratory study of the discovery and selection of design methods in practice". *Journal of Mechanical Design*, *138*(10), 101109.

Gordon, P., Kramer, J., Moore, G., and Agogino, A.M. (2017), "A systematic review of human-centered design for development in academic research", *Working Paper* 1201, BEST Lab UC Berkeley .

Gov.UK. (n.d.), *Department for International Development*. Retrieved January 1, 2016, from https://www.gov.uk/government/policies?organisations[]=department-for-international-development
Harder, M. K., Burford, G., and Hoover, E. (2013), W"hat Is Participation? Design Leads the Way to a Cross-Disciplinary Framework". *Design Issues*, 29(4). http://doi.org/10.1162/DESI
Harzing, A. W. (2007), *Publish or Perish*. Retrieved from http://www.harzing.com/pop.htm
IDEO. (2009), *Human-Centered Design Toolkit*.
Jagtap, S., Warell, A., Hiort, V., Motte, D., and Larsson, A. (2014), "Design Methods and Factors Influencing Their Uptake" In *Product Development Companies: A Review. International Design Conference* - Design 2014. Dubrovnik - Cavtat - Croatia.
Janzer, C. L., and Weinstein, L. S. (2014), "Social Design and Neocolonialism. Design and Culture". http://doi.org/10.2752/175613114x14105155617429
Jones, J. C., and Thornley, D. (1962), (eds). In *The Conference on Design Methods: papers presented at the conference on systematic and intuitive methods in engineering, industrial design, architecture and communications*. London: Pergamon Press.
Kardos, G., and Smith, C. O. (1979), "On writing engineering cases". In *Proceedings of ASEE National Conference on Engineering Case Studies* (pp. 42-50).
Khanna, T., Palepu, K.G., and Bullock, R. (2010), "Winning in Emerging Markets: A Road Map for Strategy and Execution". *Harvard Business Review Press*, Cambridge, April 28 2010.
Levine, D. I., Agogino, A. M., and Lesniewski, M. A. (2015), "Design Thinking in Development Engineering". *Proceedings of the 2015 Harvey Mudd Design Workshop IX*.
LUMA Institute. (2014), Retrieved December 6, 2014, from https://hbr.org/2014/01/a-taxonomy-of-innovation
National Academy of Engineering. (2008) *Grand Challenges for Engineering*.
Owen, C. (2001), "Structured Planning in Design: Information-Age Tools for Product Development". In: *Design Studies* 17.1, pp. 27-43
ParticipationCompass. (2014), Retrieved December 6, 2014, from http://participationcompass.org
Peace Corps. (2007), *Participatory Analysis for Community Action (PACA) Training Manual*.
Perez, Y., R. Shelby, D. Edmunds, A. James and A.M. Agogino (2015), "Social Factors in the Age of Social Media – A Multidisciplinary Approach," special chapter in *Death and Life of Social Factors* (eds., Georgia Lindsay and Lusi Morhayim), Cambridge Scholars Publishing, pp. 166-187. ISBN (10): 1-4438-7734-4
Polak, P. (2008), *Out of Poverty. Berrett-Cochler Publishers Inc.*
Ramirez, M. (2011), "Designing with a social conscience: An emerging area in industrial design education and practice". In *DS 68-5: Proceedings of the 18th International Conference on Engineering Design (ICED 11), Impacting Society through Engineering Design, Vol. 5: Design for X/Design to X, Lyngby/Copenhagen, Denmark, 15.-19.08. 2011*.
Roozenburg, N. F. M., and Eekels, J. (1995), *Product Design: Fundamentals and Methods*. John Wiley Sons Chichester.
Roschuni, C. (2012, Fall), *Communicating design research effectively* (PhD), University of California, Berkeley.
Roschuni, C., Agogino, A. M., and Beckman, S. L. (2011), "The DesignExchange: Supporting the design community of practice". In *Proceedings of the 18th International Conference on Engineering Design (ICED 11)* (Vol. 8), Lyngby/Copenhagen, Denmark.
Roschuni, C., Kramer, J., and Agogino, A. M. (2015), "Design Talking: How Design Practitioners Talk About Design Research Methods". *Proceedings of the 12th International on Design Education DETC15*, 1–8.
Service Design Tools. (2009), Retrieved December 6, 2014, from http://www.servicedesigntools.org
Strauss, A., and Corbin, J. (1994), "Grounded theory methodology". *Handbook of Qualitative Research*. http://doi.org/10.1007/BF00988593
Thomas, A. (1999), "What makes good development management?" *Development in Practice*, 9, 9–17. Retrieved from http://www.ingentaconnect.com/content/routledg/cdip/1999/00000009/F0020001/art00003
USAID. (n.d.), What We Do. Retrieved January 1, 2016, from https://www.usaid.gov/what-we-do
Ulrich. K.T., Eppinger, S.D. (2016), "Product Design and Development", McGraw Hill Education, 6th edition.
United Nations. (2000), *Millennium Development Goals*. Retrieved January 1, 2016, from http://www.un.org/millenniumgoals/
United Nations. (2015), *Sustainable Development Goals*. Retrieved January 1, 2016, from https://sustainabledevelopment.un.org/sdgs

ACKNOWLEDGMENTS

The authors wish to thank our collaborators at Berkeley and M.I.T. for their input and dedication to *theDesignExchange* and for conducting the systematic literature review that provided the dataset underpinning the design for development case studies collection. This work was partially supported by NSF CMMI-1334361.