

# OVAHIMBA COMMUNITY IN NAMIBIA VENTURES INTO CROWDSOURCING DESIGN

Colin Stanley, Department of Computer Science, Polytechnic of Namibia, Namibia  
Heike Winschiers-Theophilus, Department of Computer Science, Polytechnic of Namibia, Namibia  
Edwin Blake, Department of Computer Science, University of Cape Town, South Africa  
Kasper Rodil, Department of Architecture, Design and Media Technology, Aalborg University, Denmark

**Abstract:** Mobile crowdsourcing presents a new avenue for remote communities to participate in socio-economic activities. We are co-designing a mobile crowdsourcing platform to support rural indigenous communities in formulating their own tasks to be crowdsourced rather than completing tasks for others. We present one full simulated cycle of task formulation and evaluation by a pilot community in Northern Namibia. Observations and interactions led to a set of requirements and design implications to support the inclusion of OvaHimba communities into crowdsourcing activities.

**Keywords:** Crowdsourcing, Namibia, Indigenous People, Indigenous Knowledge, Task Formulation, ICT4D, Requirements Evaluation

## 1. INTRODUCTION

In this paper we present a community-based approach to co-design of activities a mobile crowdsourcing platform, with a rural OvaHimba community in Northern Namibia.

Crowdsourcing as an activity and topic has established itself rapidly in the commercial, scientific and academic sector. Companies and institutes have realized major benefits in terms of economizing on resources through outsourcing tasks to a wider crowd. Crowdsourcing has shown significant benefits due to the fact that a single task can be solved by thousands of different individuals with different skills, work ethics, flexible working times, and open innovation (Pedersen et al, 2013), (Bartling & Friesike, 2014). The task requestor therefore has a variety of cheaper high quality delivered products to choose from. A few prominent examples from developed countries where crowdsourcing concept had made a large income turn over are: Threadless – t-shirt design competition, InnoCentive – solving complex scientific problems by research and development, iStockphoto – allows random photographers to upload photos and get paid if their photo is downloaded, and Goldcorp challenge – allowed the crowd to examine proprietary geographical data to spot where the gold might be.

With overall good coverage and access to mobile communication devices in Sub-Saharan Africa, even members of rural communities can now participate on equal terms. Sub-Saharan African region has the highest mobile subscription penetration increase rate about 20% per year in the world according to GSMA Intelligence (2014). Mobile crowdsourcing presents a new avenue for job creations and consequently socio-economic developments in rural to peri-urban Africa (Maradona, 2012). Initiatives such as txteagle, now renamed to Jana (Jana, 2014), are targeting emerging markets like Kenya and Rwanda, where the active platform was launched in 2009 with the premise of creating employment opportunities. Another initiative is the Ushahidi (Ushahidi, 2014) project from Kenya which collects data from the crowd and presents it in a well visualized format for the public to make informed decisions.

As local researchers involved in rural software development, we are interested in reversing the roles and creating a mobile crowdsourcing platform which supports rural communities to formulate their own tasks to be crowdsourced. Not much research has been published in this area which presents a set of special challenges. While internet connectivity and English literacy could be identified as hurdles, our major concern at this stage is task formulation and refinement to obtain desirable solutions.

Crowdsourcing in the traditional sense of distributing tasks is inherent in the daily lives of rural OvaHerero and OvaHimba communities (Stanley et al, 2013). Farm activities that require many people to work together, e.g., branding cows inevitably cause people to work together without expectation of monetary payment. The concept of voluntarily helping each other in the OvaHerero or OvaHimba communities has an adage that goes “Ouzeu kaurarere ndo imwe” translated as “a problem does not always lie on one’s hip”; this means that today you might face a problem and tomorrow it might be me with a problem, so let us rather help each other today.

We first describe the context of the overall research project which scopes the tasks to be crowdsourced. We then report on the activities and findings of the task formulation with the OvaHimba, the development of a solution as well as the evaluation thereof, followed by a discussion and design implications for the mobile crowdsourcing platform. The focus in this paper is on the formulation and investigation of the rural communities’ backend of the platform rather than the crowdsourcing activity itself.

## **2. RESEARCH METHODOLOGY**

We regard the field of ICT4D as being inherently multi-disciplinary and we approach it from an action research based point of view; mostly viewed as a paradigm rather than a specific methodology (McKay & Marshall, 2001), (Reason & Bradbury, 2013), (Hayes, 2011), (Hayes, 2012). The intention has been to achieve a dual aim of action intervention and research learning; our pragmatist epistemology avoids the separation of action and thinking (Dewey, 1929). Given our background in experimental computer science this has always involved building computing artefacts, intervening with communities and then reflecting on the experience of using such a system: a design-implement-reflect cycle. This research method needs to be seen in the context of experimental computer science, which traces its heritage from engineering where progress is achieved via the design of a novel computing artefact.

We realize that designers have to work with users as co-designers and together identify the problem that needs to be addressed, the means of tackling the issues and then together decide on measures of success. The systems are designed and evaluated using Community-Based Co-Design (CBCD) methods (Blake et al, 2011), (Winschiers-Theophilus et al, 2012).

### **2.1. Community-Based**

“Community-Based” conveys the fact that we deal with groups of people rather than individuals; whereas in the developed world mobile phones and computers are geared to individual requirements (Reitmaier et al, 2011). We need to remain sensitive to major cultural differences and develop ways of entering into design conversations with people who do not have technical skills but who are knowledgeable on their own needs and especially how their own communities operate. We realize too that there is no one community with whom we work. In every design situation there are many communities: the elders, the youth, women, migrants, people with disabilities, and so on. Each of these has to be given a voice in design. In order for that to happen we must recognize groups of stakeholders and consider how all the diverse needs might be investigated.

### **2.2. Co-Design**

“Co-design” derives from the application of the participatory action research paradigm in a design setting: both the computer experts and the community members are designers on an equal footing

and work cooperatively. There is an ambiguity in the use of the term “co-design” in the literature. For some co-design is something done in the early stages of eliciting user requirements and signifies using techniques such as cultural probes, generative sessions, technology probes and so forth. From our point of view this is better called “early stage co-design” (Ramachandran et al, 2007), (Yoo et al, 2013) (also see Marti and Bannon (2009) for a critical discussion of different ways of managing user-involvement). We employ all of those techniques where appropriate but co-design goes further when combined with action research and continues to all stages of artefact development and evaluation. This is part of a trend in empowering people and moving away from rhetoric of “compassion” (Rogers & Marsden, 2013): from ICT for D to D with ICT.

Once stakeholders have been identified a common language has to be developed. With sophisticated users this language can be based on crude mock-ups of a computer interface (“paper prototypes”) since such people can readily imagine how this might work in an ICT artefact. Where a common understanding of technology does not exist, co-designers have to be given insight into the possibilities offered by the technology by means of approximations implemented using that very technology. A key feature of co-design is for technical experts to keep their own design decisions in abeyance. It is a serious mistake to commit (psychologically) to a design solution before the co-designers have found their voice.

### **3. RESEARCH AND PROJECT CONTEXT**

#### **3.1. Research Context**

The investigation into rural communities’ crowdsourcing is part of an international long-term research project. The main focus of the research has been twofold. Firstly possible representations of Indigenous Knowledge (IK) in various forms were explored, having concentrated on visual representations in the latest developments. The importance of preserving IK is to avoid valuable IK perishing when the elders passed away. Recognizing IK also instils pride in their traditions with the coming generation. Secondly our design methods are continuously refined.

#### **3.2. Transferability of Tools and Techniques**

A tool named the HomeSteadCreator (HSC) was co-created with OvaHerero Elders in Erindiroukambe, Eastern Namibia. The HSC is a tool in which IK holders can create and navigate a 3D representation consisting of context specific modelled objects. The representation creates the context to embed and structure local knowledge in a spatial manner (Rodil et al, 2012). We need to note here that OvaHerero traditions have a strong location based rule system, in terms of placement and orientation of infrastructures (house, cooking fire, cattle kraal, etc..) as well as activities such as who sits where, who walks which way, where is what cooked, etc...

Our original system was co-developed within a single community. We next investigated the transferability of the tool and associated methods through evaluations with other communities in Northern Namibia as well as far as a Penan community in Borneo (Winschiers-Theophilus et al, 2013). While the general features of the system (that is, its 3D nature and interaction methods) were well accepted, the 3D graphical elements definitely require local adaptations. This is now the challenge we need to address.

### **4. CROWDSOURCING 3D OBJECT CONSTRUCTION**

Each ethnic group has their own cultural markers in terms of activities and physical objects, such as the architecture of houses, homesteads, etc. Thus in orders to use the HSC within a locality most graphical object need to be specifically designed and imported into the application. Generic models simply do not work and lead to confusion. Considering the demand on graphic designers and the lack of resources, we are investigating the possibility of crowdsourcing the construction of

3D objects. We promote an independent adaptation process for a number of communities in Namibia based on demands individually formulated by each specific community.

#### 4.1. Community Crowdsourcing Study

Although rural communities in Namibia do have mobile connections they seldom make use of the opportunities available on the internet. Because of language and conceptual differences an involvement in crowdsourcing activities seems challenging. We thus explore an avenue on how to close the gap between rural Namibian communities and the crowd on the internet. We are investigating requirements for a crowdsourcing platform from the rural communities' perspective and therefore a community-based co-design is required.

In order to gain insights into the requirements for the crowdsourcing platform we have simulated one full crowdsourcing cycle with one OvaHimba pilot community in Northern Namibia. At this point the mobile version is not linked to the central database managing the tasks and users. Thus, for the purpose of the solution evaluation by the community, we have simulated the development and pre-loaded the 3D models. We initially spent one day at the village, introducing ourselves and the research project. Three elderly men agreed to spend the entire morning with us and requested us to work with the women separately in the afternoon. We started by introducing the OvaHerero version of the HSC to demonstrate the development of community-based IK preservation. Within this context community members then formulated tasks by requesting for specific 3D objects to be modelled. Upon obtaining a number of 3D objects from a graphic designer, we returned to the same community for one full day of evaluation of those models. Based on the observations and discussion we formulated a number of design implications and identified further research topics.

#### 4.2. OvaHimba Pilot Community

The crowdsourcing task formulation and evaluation took place in Ohandungu, a rural OvaHimba community, in the northern region of Namibia. The OvaHimba and the OvaHerero share a related cultural heritage. The OvaHimba settled in the northern part of Namibia while the OvaHerero live further south.

Thus the decision to work with the OvaHimba tribe was based on the fact that the OvaHimba and the OvaHerero people still share a number of similar traditional practices. Both tribes are semi nomadic cattle and small livestock breeders and perform small scale crop production. For example, they share traditional rituals of the holy fire and the dual descent *oruzo* 'patrilineage' and *eanda* 'matrilineage'. All these similarities could be linked to the fact that both tribes descend from the same matriclan and therefore there are only minor dialectical language differences. However the OvaHimba traditional houses, homestead arrangements, and traditional attire are very different from the OvaHerero. These underlying similarities of tradition with a set of external differences present an ideal case to investigate for the transferability of the HSC technology by maintaining the features yet allowing changes to the interface objects.

For the deployment of the HSC tool, we were particularly interested in the homestead components and setup (Figure 1). The kraal and homestead yard of the OvaHerero are modern designs with poles and wires bought



**Figure 1 Left: OvaHerero. Right: OvaHimba homestead**

from agricultural shops and are mostly constructed in a square shape, while the OvaHimba materials are mostly cut from the bush and are constructed in circular shapes. The kraal for the cattle and small livestock of the OvaHimba is constructed inside the homestead yard while the OvaHerero cattle kraal is mostly constructed in front of the yard while the small livestock is constructed behind the homestead yard. The main house of the men of the homestead, always face the gate of the cattle kraal for both tribes. The family houses of the OvaHimba people are constructed in a circular line from both side of the main house while the OvaHerero family houses are constructed more in single line from either side of the main house.

## 5. COLLECTING AND FORMULATING TASKS

### 5.1. Workshop Sessions Setup

The day at the village was split in two parts consisting of a number of sessions. The morning was dedicated to the three elder men and the afternoon to three women. All sessions were facilitated by the Otjiherero speaking researchers and authors of this paper.

One of the researchers introduced the idea and benefits of digitizing their IK. Thereafter the participants were shown a prototype of the OvaHerero version of the HSC to envisage the possibility on how their IK could be digitized. The elders understood the rationale of digitizing traditional knowledge quite well and enjoyed using the HSC for the first time. This was noted by their joyous laughter when one of the men moved one of the homestead elements to his preferred location on the screen. While enjoying the features of the tool, the three elders clearly expressed the inadequacy of the elements with jokes such as “are we now forced to marry an OmuHerero woman?” Such remarks confirmed the engagement with the system and the need for an adaptation of the system to the OvaHimba culture. The participants were informed that the OvaHerero graphics on the HSC could be replaced with the graphics of the OvaHimba tribe.

We explained to the participants that they could also participate in crowdsourcing by taking pictures of their rural surroundings or uploading drawings to be transformed into 3D format to be added into the HSC. An amazing experience was the speed with which the community members grasped the idea of the tool as well as the skills in the technology interactions, which were mostly touch-based. The participants knew exactly what they wanted to be modelled in 3D.

One of the elders was given a tablet to take pictures (Figure 2); he walked directly to the holy fire location to take his first images. After taking the pictures of the holy fire, he instructed the researcher to move to the next object the *Otjoto* (thatched roof) which is constructed close to the cattle kraal. While on the way to the *Otjoto*, he took pictures of the *Ozombande* which are poles where meat is kept and he made sure he took the whole of the *Ozombande*. The *Otjoto* is an important place in the OvaHimba homestead, for example, a groom and bride are taken to sleep there during the wedding ceremony. From the *Otjoto* the elders informed the researcher that the next object is their house and while on the way he already instructed one of the ladies to bring out the calabash *ehoro*, which is a big cup made of wood used to store *omaere* (soured milk), *ombako* a filter used to pour the milk in the calabash. While the items were brought outside the house, the men made a comment that “our tradition would now not vanish if it is given to these people” (meaning: stored in the digital system). The men told the woman precisely where the calabash, *ehoro* and the filter should be placed beside the house. For the next picture he called one of the ladies to come and stand in



**Figure 2 Elder taking photographs**

front of the house beside the calabash for him to take the picture and he showed the lady how he wanted her to sit or stand for different pictures and also asked another lady to stand alone separately from the house to take pictures of her. The next object was a tree and he got everyone including the researchers, goats and dogs to move away from the tree so that he could take a picture of the tree by itself. Next the men photographed the *orutara*, a place where food like maize corn is stored to dry, and *oturua*, a food store. He also took images of the goat and cattle kraal.

After the elder was finished, a woman took the tablet. She walked straight to the holy fire to take her first images. Then she took pictures of the kraal and then she went to the house area to take pictures of the two different houses. The interesting part was that the woman was walking with a young girl who requested taking the next pictures of the *oturua*. This shows how the youth could work with the elders once the application is deployed. The woman then asked the girl to take pictures of her. From there she took pictures of goats and dogs separately. She asked for pots and took pictures of them.

As the participants from both sessions had taken several pictures, only a few were selected for use on the mobile-based crowdsourcing platform that allows for uploading of photos, pictures and other files (Stanley et al, 2013). A lot of pictures of the same object were taken and the selection criteria were based on the participants' choices of the picture quality and the importance of the objects in their culture. The woman also selected pictures that the man had taken.

## 6. EVALUATING SOLUTIONS

Two months after the first visit we returned to Ohandungu with the aim to get some of the ordered 3D modelled objects evaluated by the community members. Similarly to the first visit, two sessions were conducted with the same participants. The sessions included five researchers, three male elders and four woman of the Himba community, respectively. One of the OvaHerero speaking researchers facilitated the sessions. The elders were tasked to evaluate the graphical models based on the images they had taken and selected during our previous visit. The graphics were presented on a laptop. The elders gathered together while the women sat in proximity waiting for their turn and meanwhile browsing through the photos taken at the last visit.

The initial discussion centred on the graphics of the hut (Figure 3). The first part the elders commented on was the roof of the modelled hut. The elders jokingly said that it's not their house which was modelled. One of the elders asked who the people are who built these houses. The researcher asked if the house modelled existed in Opuwo. The elder commented that they existed as some other places. Asked to describe his house (the one on the



**Figure 3 Left: Real Hut, Right: 3D Modelled**

photo) he replied that his house also had grass on the roof, but the tying of the grass is not the same. Jointly inspecting the photo taken of the house they pointed at the tying of the grass. In the discussion around the modelled hut, the elder mentioned that it was the house he would like to have had in real life. "The hut is beautiful" he said. It was represented stunningly; "perhaps cause of the tablet" was a comment from the other elder. Back to the discussion of the roof which was "too perfect", because the cutting of the roof was well structured not like the real one. We then asked whether the representation should be adapted to the real one. The elders concluded that they liked the way it was represented although the roof remained very interesting to them. The elders expressed their appreciation for being able to inspect the model from all sides in the 3D presentation.

Looking at the graphics of the calabash, the elders thought it was an “*orumba*”, where fat was placed. The elder asked where the neck of the *orumba* was. The researcher then showed the photo of the calabash (Figure 4, left), just for the elder to realize that they are talking about different objects. Again the elder commented that the calabash looks good but that the cap was missing, which prevented flies from going in. The cap must be very small. One of the women commented on the calabash saying it was so ugly and should therefore be deleted completely. She requested for the tablet so that she could show what the real calabash looked like on one of the photos. She showed that they were different in terms of the cap of the calabash. The most vivid discussion followed about the representation of the OvaHimba woman (Figure 4). Firstly one of the elders asked what kind of a person this was and from where. The elders mentioned that it’s



**Figure 4 Left: Image, Right: 3D Model**

not one of their women, especially looking at the clothes. One of the elders pointed at one of the OvaHimba women seated next to them asking her to check the difference with the representation. Another elder speculated that the model was crippled, that she only had one arm (as they could not see the other arm). They further commented that she had no clothes on. The elder kept referring to the real woman next to him. He then contemplated that she was maybe from another tribe, maybe from the “OvaTwa” (another indigenous Namibian tribe) living in the mountains. The researcher asked what needed be addressed with the image, and the elder said that the image should be thrown away. It was not a woman at all. Then the elder inquired if there was a picture taken of the woman. The reference photo was shown (Figure 4, left). After seeing the picture, the elder identified the woman on the photo but remarked that the model was not her. He mentioned that the woman could be fat, but most importantly the dress code was not right and not the same. The elder asks one of the women to stand up, so that everyone could see how the woman looked. Repeatedly complaining about the modelled clothes, they asked to juxtapose the photo and the model. The elder then called the woman to come around and look at the images. “Is it a ghost or a tree”, “the woman has no arms and fingers” were further comments from the elders.

They then requested to inspect the model from different perspectives but due to a technical problem the 3D version could not be demonstrated. In conclusion they agreed that the shape was fine, but the problem was with the clothing. Some significant details were omitted such as the folding of the leather and the ornaments in the hair. We need to note here, that the OvaHimba have codified attire, meaning that different ornaments and hair style signify the marital and societal status. This explains the significance the community members attached to a correct representation of the clothes. One of the elders decided to take a series of pictures of one woman from all the different angles (Figure 2), to be sent to the graphic designers to do a better job.

Since they also needed a good 3D model of the OvaHimba man the same elder decided to pose for a series of pictures from different angles. When he later realized that he was wearing a non-traditional shirt the photos were retaken.

## 7. DISCUSSION AND DESIGN IMPLICATIONS

Based on the interactions during the two phases we extracted issues that have direct implications for the design of a crowdsourcing platform and further research endeavours.

### 7.1. Precision in Task Choice

The man and the woman who captured the images knew exactly what they wanted, in what position and what pose. The confidence of the choices, and the informative conversations during this exercise was an extremely rewarding exercise. The versatility of their use of the system and the overall understanding of the project as well as the concept of crowdsourcing encouraged the research team to pursue development further.

### 7.2. Realistic versus Ideal Representations

Considering the discussion that took place around the hut, we observed that in the first instance the graphical representation does not get recognized as the reference to the representation. As the discussion progresses about the differences between the real and the represented one, the elders frequently start liking the representation as an idealization or beautification of reality. The question remains, how do we ensure that the representation is to the satisfaction of the client, the community in this case, independent of our own aesthetic understanding?

### 7.3. Quality of Feedback

Considering the discussion around the woman model where from the beginning till the end the community disagreed with the attempt pointing out all the faults and omissions, suggest that such valuable feedback should be recorded, transcribed, translated and communicated to the graphic designers (Figure 5). Equally the decision to take a series of new pictures demonstrated the elders' understanding of the 3D design process, where folding of leathers can only be seen from a certain perspective.



**Figure 5 Community Feedback**

A rapid design approach might be required whereby the first draft of the graphic should be produced within a very short time to just to trigger feedback from the rural communities which then could be added to the photo to constitute the complete task to be published back to the crowd. Another approach could be to let the rural communities annotate the photo to put emphasis on the features that should not be missed. Perhaps if the difficulties encountered by the graphic designer while constructing the 3D objects were communicated in real time to the community it would have aid in refining the task requested.

### 7.4. Evaluation and Refinement Cycles

We acknowledge that one cycle of delivering the objects was not sufficient considering the likelihood of satisfying the community requirements. Therefore we suggest several cycles for the evaluation and refinement of the objects until they are accepted by the community. The challenge is on how to maintain the refinement cycles effectively. Another open question is that perhaps those graphic designers that created graphics that were not accepted could work faster during the refinement process since they were initially interested in the given task instead of completely new designers. We are aware that there will be a considerable language problem once the intermediate researchers that speak Otjiherero are no longer part of the crowdsourcing cycle and thus we are looking into appropriate solutions to overcome this obstacle.

### 7.5. Technical Issues

A major constraint was the sunlight reflection (Figure 2) on display screens where one of the researchers had to hold the umbrella to provide shade. We are currently working on a hardware solution to overcome the problem. Physical environmental conditions such as wind blowing dust

causes the tablet screen to be frequently cleaned during the sessions. To our amazement the *otjize* which is the reddish body cream used by the OvaHimba women was not a problem on the touch screen.

## 8. CONCLUSION

Crowdsourcing may be an economically viable option to support model adaptation. However, pursuing the development of a mobile crowdsourcing platform for rural indigenous communities, to do their own task and user management, unveils a number of different challenges on a theoretical and practical level.

In a first attempt to understand the design implications for such a platform we have run a full simulated crowdsourcing cycle with a pilot OvaHimba community. Although the task scope was reduced to the request of 3D models of their choice, the complexity of task formulation, design and feedback was apparent. Photos taken by community members are clearly insufficient to inform the graphic designer where to direct the focus of representation. While some contextual knowledge is necessary the feedback on the first attempts seems most valuable. Refinements on the design of the task formulation as well as the evaluation cycles will have to be considered to ensure a satisfactory solution.

Our investigation further demonstrates the opportunity for co-designing a rural crowdsourcing platform with community members who have not yet benefited from the internet but have bought into the wider idea of crowdsourcing. We have realized how within the interactions, community members have conceptualized the digitalization of their IK as well as on how to communicate requests to an unknown crowd.

## 9. ACKNOWLEDGMENTS

We thank the community of Ohandungu for welcoming us and their commitment to the past and future activities in the project. We also thank them for having given us informed consent on the utilization of all photos taken during our visits. We further acknowledge the funding source being from a bilateral agreement between Namibia and South Africa.

## 10. REFERENCES

- Bartling, S., & Friesike, S. (2014). Opening Science: The Evolving Guide on How the Internet is Changing Research, Collaboration and Scholarly Publishing, *Open Innovation and Crowdsourcing in the Sciences* (pp 255 - 257)
- Blake, E. H., Tucker, W. D., Glaser, M., & Freudenthal, A. (2011). Deaf telephony: community-based co-design (case study).
- Dewey, J. (1929). The quest for certainty: A study of the relation of knowledge and action. *New York: Minton, Balch.*
- GSMA Intelligence. (2014). *Mobile trends in Sub-Saharan Africa*. Retrieved from <https://gsmaintelligence.com>
- Hayes, G. R. (2011). The relationship of action research to human-computer interaction. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 18(3), 15.
- Hayes, G. R. (2012). Taking action in your research. *interactions*, 19(4), 50-53.
- Jana. (2014). Our Vision. Retrieved from <http://www.jana.com/>
- Maradona, G. (2012). *Predicting Intention to Participate in Mobile Crowdsourcing Initiatives: A Study of Local Kenyan Communities* (Master's thesis, University of Witwatersrand, Johannesburg, South Africa). Retrieved from [http://wiredspace.wits.ac.za/bitstream/handle/10539/12467/Research%20report-\(final\)-revised%20submission-MGatara\(494525\).pdf?sequence=1](http://wiredspace.wits.ac.za/bitstream/handle/10539/12467/Research%20report-(final)-revised%20submission-MGatara(494525).pdf?sequence=1)

- Marti, P., & Bannon, L. J. (2009). Exploring user-centred design in practice: Some caveats. *Knowledge, technology & policy*, 22(1), 7-15.
- McKay, J., & Marshall, P. (2001). The dual imperatives of action research. *Information Technology & People*, 14(1), 46-59.
- Pedersen, J., Kocsis, D., Tripathi, A., Tarrell, A., Weerakoon, A., Tahmasbi, N., ... & de Vreede, G. J. (2013, January). Conceptual foundations of crowdsourcing: A review of IS research. In System Sciences (HICSS), 2013 46th Hawaii International Conference on (pp. 579-588). IEEE.
- Ramachandran, D., Kam, M., Chiu, J., Canny, J., & Frankel, J. F. (2007, April). *Social dynamics of early stage co-design in developing regions*. In Proceedings of the SIGCHI conference on human factors in computing systems (pp. 1087-1096). ACM.
- Reason, P., & Bradbury, H. (Eds.). (2013). *The SAGE handbook of action research: Participative inquiry and practice*. Sage.
- Reitmaier, T., Bidwell, N. J., & Marsden, G. (2011). Situating digital storytelling within African communities. *International Journal of Human-Computer Studies*, 69(10), 658-668.
- Rodil, K., Winschiers-Theophilus, H., Jensen, K. L., & Rehm, M. (2012, October). Homestead creator: a tool for indigenous designers. In *Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design* (pp. 627-630). ACM.
- Rogers, Y., & Marsden, G. (2013). Does he take sugar?: moving beyond the rhetoric of compassion. *interactions*, 20(4), 48-57.
- Stanley, C., Winschiers-Theophilus, H., Onwordi, M., & Kapuire, G. K. (2013, December). Rural communities crowdsource technology development: a Namibian expedition. In *Proceedings of the Sixth International Conference on Information and Communications Technologies and Development: Notes-Volume 2* (pp. 155-158). ACM.
- Ushahidi. (2014). *Ushahidi's Mission*. Retrieved from <http://www.ushahidi.com/>
- Winschiers-Theophilus, H., Bidwell, N. J., & Blake, E. (2012). Community consensus: Design beyond participation. *Design Issues*, 28(3), 89-100.
- Winschiers-Theophilus, H., Winschiers-Goagoses, N., Rodil, K., Blake, E., Zaman, T., Kapuire, G. K., & Kamukuenjandje, R. (2013). Moving away from Erindi-roukambe: Transferability of a rural community-based co-design. *IFIP WG*, 9.
- Yoo, D., Huldtgren, A., Woelfer, J. P., Hendry, D. G., & Friedman, B. (2013, April). A value sensitive action-reflection model: evolving a co-design space with stakeholder and designer prompts. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 419-428). ACM.