Institution: Swansea University		
Unit of Assessment: 11		
Title of case study: Empowering Slum, Township and Rural Communities in the Developing World to Participate in and Shape the Digital Future		
Period when the underpinning research was undertaken: September 2006 – December 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Simon Robinson	Senior Lecturer	2007 – present
Jennifer Pearson	Senior Lecturer	2008 – present
Matt Jones	Professor	2005 – present
Period when the claimed impact occurred: August 2013 – December 2020		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Digital technologies are typically created for "conventional users" in the developed world assuming a base set of cultural norms, resource availability and technological experience that diverge from those for "emergent users" in the developing world. Emergent users are typically poorer, have lower educational attainment and literacy levels and less access to digital technology than conventional users. Since 1st August 2013, our group in the Future Interaction Technology Lab has trained hundreds of community members in sub-Saharan Africa, India and South America to become innovators, provided over 200,000 people from around the world with new digitally mediated services (e.g., new types of interactive speech assistants and content editing tools) and shaped public and organisational understandings and practices.

2. Underpinning research

The underpinning research began in 2006 when Jones co-led two research projects emerging from an EPSRC initiative to "bridge the global digital divide" [**G1, G2**]: at that point, approximately only 17% of the world population had access to the internet (in 2020 this has risen to 50% (World Bank)). The early impacts of this work were reported in a REF 2014 Impact Case Study focused primarily on extending access to devices and services to people on the wrong side of the "digital divide". In the subsequent seven years of the REF 2021 period, the emphasis has moved to a higher-level and structural access problem – that is, how to involve "excluded" individuals in directly shaping innovations rather than simply make such services more accessible or useful to them. This work has been funded by a responsive-mode EPSRC grant [**G3**], the UKRI-funded CHERISH Digital Economy Centre [**G4**], a Royal Society Wolfson Research Merit Award (Jones) [**G5**] and a Google Internet of Things Technology Research Award (Jones, Robinson, Pearson).

The key insights relate to a methodology we developed called "itinerative" design, a community-driven innovation approach that involves phases of iteration and movement from community to community [**R1**]. Each itinerative design phase begins when the core interaction team visits a driver community (e.g., the townships of Cape Town; see [**R1, R4**] for attendee details) to conduct intensive innovation workshops aimed at identifying a series of interaction challenges and designing potential technology interventions. Rapid in situ generation of use cases and low-fidelity prototyping are documented before the results are presented to local technology experts, NGOs, cultural commentators and other stakeholders for response and refinement. Next in the process is the development of a series of prototypes of services (using purpose-built hardware and software as well as off-the-shelf devices such as mobile phones and smart speakers) to address the opportunities identified during the initial workshops. These prototypes are iteratively developed by the research group and piloted across several different emergent user communities (e.g., communities in Kenya and India), being refined and adapted in each iteration. Long-term deployments are then undertaken within multiple regions, with interpretations, refinements and adaptations occurring throughout. Finally, at the end of the process, we explore how the resulting technologies could benefit conventional users.

In this REF period we have published the details of the methodology (e.g., [**R1, R4**]) and a range of articles that present outcomes of the process, illustrating how engagement with such communities brings globally relevant insights into future technologies. For example, our work with female domestic workers, rickshaw drivers and peri-urban school children in Bangalore led to the "APPropriate" phone concept, allowing people to borrow and use others' devices as their own, increasing resilience and security by removing the need to carry devices in public [**R3**]; design workshops with township residents in Cape Town led to a platform allowing multiple mobile devices to be used in tandem, combining their capabilities and interactions [**R6**]; work with nomadic market traders in Nairobi helped shape use cases and identify challenges of novel Internet of Things infrastructures [**R5**]; and, deployments of speech assistants in public settings in an Indian slum and a South African township have helped uncover future improvements for such devices for the rest of the world [**R2**].

3. References to the research

Evidence of quality of underpinning research: All papers [R1–R6] and grants [G1–G5] have been fully peer reviewed. All papers were supported by EPSRC funding. R5 was awarded Best Case Study at the 2017 ACM CHI Conference.

[R1]. Pearson, J., Robinson, S., Reitmaier, T., Jones, M., Joshi, A. (2019). Diversifying Future-Making Through Itinerative Design. ACM Transactions on Computer-Human Interaction 26(5):1–21. https://doi.org/10.1145/3341727

[R2]. Pearson, J., Robinson, S., Reitmaier, T., Jones, M., Ahire, S., Joshi, A., Shoo, D., Maravi, N., Bhikne, B. (2019). StreetWise: Smart Speakers vs Human Help in Public Slum Settings. Proceedings of CHI '19, paper 96. https://doi.org/10.1145/3290605.3300326

[R3]. Robinson, S., Pearson, J., Reitmaier, T., Ahire, S., Jones, M. (2018). Make Yourself at Phone: Reimagining Mobile Interaction Architectures With Emergent Users. Proceedings of CHI '18, paper 407. https://doi.org/10.1145/3173574.3173981

[R4]. Jones, M., Robinson, S., Pearson, J., Joshi, M., Raju, D., Mbogo, C., Wangari, S., Joshi, A., Cutrell, E., Harper, R. (2017). Beyond "Yesterday's Tomorrow": Future-Focused Mobile Interaction Design By and For Emergent Users. Personal and Ubiquitous Computing 21(1):157–171. https://doi.org/10.1007/s00779-016-0982-0

[R5]. Pearson, J., Robinson, S, Reitmaier, T., Jones, M., Joshi, A., Parab, C., Mogoi, F., Jenson, S. (2017). Exploring the use of the Physical Web with Resource-Constrained Communities. CHI '17 Case Studies, pp. 1117–1125. https://doi.org/10.1145/3027063.3053349 ***Awarded Best Case Study.***

[R6]. Robinson, S., Pearson, J., Jones, M., Joshi, A., Ahire, S. (2017). Better Together: Disaggregating Mobile Services for Emergent Users. Proceedings of MobileHCI '17, paper 44. https://doi.org/10.1145/3098279.3098534

Grants:

[G1]. Jones, M. (PI). (2006-2009) Bridging the Global Digital Divide Network. EPSRC, [EP/E006418/1], GBP79,359.

[G2]. Jones, M. (PI). (2006-2008) StoryBank: Sharing Stories Across Digital Divides. EPSRC, [EP/E006396/1], GBP79,818.

[G3]. Jones, M. (PI), Pearson, J, Robinson, S. (CoIs). (2014-2018) Reshaping the Expected Future: Novel Interaction Techniques for Base of the Pyramid Users and Challenges to the Orthodoxy for the Rest of the World. EPSRC, [EP/M00421X/1], GBP710,784.

[G4]. Jones, M. (PI). (2015-2021) The CHERISH-DE Centre – Challenging Human Environments and Research Impact for a Sustainable and Healthy Digital Economy. EPSRC, [EP/M022722/1], GBP3,091,610.

[G5]. Jones, M. (PI). (2014-2019) Information Interaction for "Bottom of the Pyramid" Users in Developing Regions. The Royal Society, [WM130070] GBP75,000.

4. Details of the impact

In the REF2021 period:

(i) **Emergent user community members** in South Africa, Kenya and India have been **trained to become innovators**, shaping technologies that have been deployed, and gaining skill-sets – such as ideation, design and evaluation – for future work with NGOs and stakeholders:

- The Swansea team have worked closely with **138 emergent users during six future-making innovation workshops in South Africa, Kenya and India**. Impact on these people is evidenced by the achievements of our community link members: For instance, one person set up a research team in her township that employs local residents. She notes that "*the research methods developed by the Swansea team have enabled me to upskill and employ Langa residents to work with other clients [...] who want to understand the needs of our communities*" [**C2**].
- NGO responses provide further evidence of impact. For example, a representative from Project codeX said, "*We recognise the unique approaches created by the team which can inspire software developers to learn and deploy methods that involve diverse and rich perspectives for the good of all*" [**C2**].
- Post-event surveys taken by emergent users also indicated impacts (e.g., *"[the workshops] showed me that as much as you think an app is a difficult thing to develop, actually anyone can do it"*; *"When your voice is heard it makes you feel important"* [**C4**, pages 3 & 4]).

(ii) **Over 200,000 people** have benefited from **using globally available apps** and **deployed systems** developed at these workshops to create or access digital content in ways not previously possible. For the apps, we report cumulative download figures along with the average numbers of active users to the end of December 2020 (active users can vary daily; Google Play began reporting this metric in September 2016). Further evidence that these apps impact users is seen in their publicly accessible reviews and private communications we have had with end-users:

- The **Com-Phone digital storytelling app** (presented in the team's REF 2014 Impact Case Study), **co-designed and developed in South Africa and refined in Argentina** is publicly available on Google Play. **This app provides users with an accessible way of expressing ideas, issues and experiences**, combining photos, audio and text to tell stories. The app is widely used in "mainstream" contexts (e.g., 60% are in French schools where the app is used to enhance learning and teaching: *"I use and always recommend the Com-Phone application for schools [...] This is the first application I show in training [...] a very useful tool for written and oral production, which students can use alone, independently or in groups"* [**C2**, digital trainer for French elementary school teachers, working with 71 schools and about 540 teachers]), which evidences a key element of this Impact Case Study: that ideas generated in "developing" countries can lead to useful services for the rest of the world. The app's user base has continued to grow, and it has now had **77,000 downloads** (compared to the 25,000 downloads reported in REF 2014), with an average of **12,000 daily active users** [**C1**].
- The Better Together toolkit [**R6, C5**], which enables users' mobile phones to be used as a combined group, is used in the Android-based **Swarachakra Marathi Keyboard** (realised by IDC, IIT-Bombay, facilitated by Swansea) to enable cross-device input and display of Indic scripts. This tool has been **downloaded over 1.5M times**, with an average of **179,000 daily active users** [**C1**].
- **Public space smart speakers** have been deployed starting in 2017 in Dharavi (a large slum in Mumbai) and Langa (a township in South Africa). Over these periods (2017-2020), **users**

have benefited directly from over **16,000 interactions** with the speech assistants (evidenced by [**R2**] and subsequent publications, and [**C3**, page 1] where a news reporter from ABP News in India said *"These smart speakers are capable of answering each and every question"*), with topics ranging over politics, entertainment, wellbeing and location.

- The **APPropriate platform** enables users to use other people's devices as their own. A user in South Africa said that the *"electricity went out for a week during the storm so I couldn't charge my phone – I could still borrow a phone with charge, though"* [**R3**, page 9].

(iii) **Major corporations, small and medium-sized enterprises (SMEs) and NGOs** have had their **understanding and practice of design and development methodologies challenged and enriched**:

- Since 2015, we have led three co-creation summits in India, South Africa and Kenya, with participation from academia, industry and NGOs. These summits resulted in three toolkit launches: the Better Together toolkit (separately in Bangalore and Cape Town, 2017) and the Digital Inclusion and Participation toolkit (Cape Town, 2018) [**C5**]. In total, representatives from 36 organisations attended the launches (e.g., Microsoft, Adobe, Samsung, Tata, Xerox, Flipkart, and Dimagi) to learn about the technologies presented. Survey data from these events evidences their impact. For instance, in the 2018 toolkit launch in Cape Town, 100% of respondents (N=16) responded positively to the question, *"To what extent has this set of activities impacted on your understanding and involvement in digital design and development"* [**C6**]. This is corroborated by sources such as a Microsoft Technology and Emerging Markets Lead who said, *"Our teams – and others I know of – have been influenced by the approaches, using them to reflect on and adapt our design and innovation processes"* [**C2**].
- The team received a Google Internet of Things Technology Research Award in June 2016, and the results of this helped Google developers design a future Internet of Things infrastructure platform: *"[...] collaborating with Swansea achieved two very tangible outcomes [...] you deployed the infrastructure in a very interesting, challenging context in Nairobi that provided insights into the viability of the service for traders and market users with differing levels of technological literacy to those of 'conventional' users"* [**C2**, Google Physical Web Lead].

(iv) **Public understanding** of and **engagement** with the issues addressed by the research have been influenced through a series of **activities in the UK and India**:

- The team has given public lecture presentations and demonstrations, most recently at Asia's largest innovation showcase, TechFest (January 2020), where we demonstrated our research to at least 16,000 people. In addition, because our key drive is to demonstrate the value of an inclusive approach to innovation, we presented at the British Science Festival (September 2016; 120 attendees); the Hay Festival of Literature and Arts (May 2017; 250 attendees), the Cheltenham Science Festival (June 2018; 110 attendees); and, the Foreign Office-led India-UK FutureTech Festival (December 2018). The value of these sorts of events is evidenced by a survey we carried out at TechFest, where, out of 428 respondents, 96% indicated that we had changed their understanding of emergent user needs and the value of interacting with emergent user communities [**C6**]. Similarly, in Cheltenham, 60% of respondents (N=30) said that gaining an understanding of the diversity of emergent users' values in comparison to their own was a key positive impact for them [**C6**].
- Our work has been highlighted on radio, on television and in the press (e.g., the BBC (World Service, Digital Planet, Science Cafe, Radio Wales), The Times of India, ACM TechNews, NDTV, and ABP News, with a total reach of many hundreds of millions of people) [**C3**]. In June 2015, the team was awarded a BBC Research and Development Award for Outstanding Impact on Professions, Practices and Services. We have also been active in shaping policy; for example, the group was an active contributor to the Speaker of the House of Commons' Digital Democracy Commission, facilitating a key event in Wales that sought to understand how to create and enable inclusive use of digital services for democracy by using the tools and techniques generated by the research to discover new possibilities in terms of diverse access and participation [**C7**].

5. Sources to corroborate the impact

[C1]. Public download statistics from the Google Play Store for the Com-Phone Story Maker and Swarachakra Marathi Keyboard apps:

Com-Phone Story Maker: https://play.google.com/store/apps/details?id=ac.robinson.mediaphone
Swarachakra Marathi keyboard: https://play.google.com/store/apps/details?id=iit.android.swarachakraMarathi

[C2]. Statements from key users and beneficiaries: a Langa community link member, a representative from Project codeX (an NGO), a French elementary school digital trainer, a Microsoft Technology and Emerging Markets Lead and a Google Physical Web Lead.

[C3]. Exemplar media and reports.

[C4]. Excerpt from notes/transcript taken at the Reshaping the Expected Future project conclusion meeting with participants in Langa (Cape Town).

[C5]. Toolkit outputs from the work: https://bettertogethertoolkit.org/ and https://digitalinclusiontoolkit.org/.

[C6]. Survey results from Cape Town Digital Inclusion and Participation toolkit launch, TechFest and Cheltenham Science Festival events.

[C7]. Speaker's Commission on Digital Democracy: https://digitaldemocracy.parliament.uk/ (see the report and the Swansea-facilitated event held in Cardiff – https://youtu.be/66L_ny7QqPU?t=68)