Rescued by Design: Enabling low-resource communities to reduce global drowning

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Abstract

In recent years Bournemouth University (BU) has witnessed a growth in undergraduate projects aimed at resolving problems in low-resource communities, with an emphasis on sustainability through the use of locally-available resources and production methods. BU academics have also been involved in helping the Royal National Lifeboat Institute (RNLI) to develop product solutions to help prevent global drowning, with an initial focus on the Bangladeshi context.

Alongside the potential to enrich or even save lives in the target communities, such projects can offer considerable benefits to a range of domestic stakeholders: from the students and staff themselves to local businesses and non-government organisations (NGO's). But they can also offer considerable challenges - educationally, ethically and practically – including issues with design validation, the reliability and availability of information, and the barriers of differing cultures and languages.

How can educators support low-resource projects successfully? Can students truly gain sufficient understanding of all the relevant issues to design products for an unfamiliar culture, no matter how diverse? And why are low-resource communities looking to designers from the other side of the world to provide low-tech solutions to local problems?

Bournemouth University's low-resource projects have achieved varying degrees of success. By examining some of these - including the RNLI's Bottle Buoy, which has recently gained international acclaim - the authors explore the complex issues relating to the use of such projects in an educational context, and present a proposal for future success using jugaad strategies and greater collaboration.

Key words

drowning, low-resource, RNLI, Bangladesh, Bottle Buoy, jugaad

1   The Global Drowning Problem

The scale of the global drowning problem is huge. The World Health Organisation estimates approximately 372,000 deaths occur worldwide from drowning every year (WHO, 2016). This figure equates to around 70% of the global death toll from malnutrition, and 60% of that from malaria. More than nine-tenths of these deaths occur in Africa and South-East Asia, where drowning is often the leading killer of children over the age of one. Recent media coverage has highlighted the devastating flooding suffered in South Asia during the 2017 monsoon season - which left at least 41 million people affected across the region (Farand, 2017) – but sadly the vast majority of deaths that occur daily from drowning go unreported.

In Bangladesh approximately 50 children drown every day, usually within 20 metres of their home (RNLI, 2017). Communities are often sited close to open water, and they are heavily reliant on local ponds and lakes for daily tasks such as washing and bathing. As there is often no culture of water safety, international aid agencies and non-government organisations (NGO's) have recently been working to reduce drowning by address this. Much of the current thinking and practice in the drowning prevention community involves activity in education, influence, supervision and rescue, but in areas which have seen efficient drowning reduction activity there are still gaps in these approaches. In the UK the Royal National Lifeboat Institute (RNLI) are now increasingly focussing on design and design thinking to further resolve the issue of drowning prevention.

2   LRC Projects at BU

Students attending the BA/BSc Product Design course at Bournemouth University (BU) spend their final year developing a single product in response to a defined real-world problem of their own choosing. Projects relating to low resource communities (LRCs) have been a regular occurrence for many years at BU, with the resulting products invariably intended for industrialised manufacture.

However, there has recently been a notable increase in designs devised by BU students which attempt to enable communities to resolve these issues at a local level, focussing on utilising local resources and production methods rather than imposing western industrialised solutions. Recent examples – primarily aimed at rural communities in Bangladesh and Tanzania - have included a resuscitation training manikin; a playpen (Figure 1); school furniture; and 'man overboard' recovery devices (Figure 2).

Figure 1

Figure 2

This move towards local production has been driven by BU's local links with the RNLI in Poole. The RNLI defines one of its long term strategic goals as to have "effective drowning prevention strategies in place in the highest risk areas internationally" (RNLI, 2015). It aims to do this through a combination of three strategies: building awareness; supporting the adoption of national plans; and providing appropriate intervention and equipment. A part of this final strategy includes the design of equipment suitable for low resource communities.

While the RNLI's own engineering and asset management department have conducted work on suitable projects, it was recognised that issuing live briefs to local students would enable extra capacity for generating solutions. The RNLI supports these briefs by offering access to technical experts and users in target communities, as well as professional test facilities. The RNLI College in Poole provides students with a rare opportunity to test their designs in their world-class Sea Survival Centre which contains a wave tank and lifeboat simulator. In return the RNLI expects students to forego intellectual property rights and allow the release of their designs on an open source basis, thus enabling benefit to the worldwide community.

Some of BU's Design & Engineering academics have also undertaken LRC project collaborations with the RNLI, most recently in helping to develop the 'Bottle Buoy' rescue device. This simple product – initially created with a focus on the Bangladesh context - aims to reduce the incidence of global drowning, and received recent recognition from the International Maritime Rescue Federation by winning the technical category in the 2016 Honouring Excellence in Rescue Operations (HERO) Awards.

While such projects offer a plethora of potential benefits to a wide range of stakeholders – not least the target communities themselves – they also present considerable challenges. The authors gathered feedback from students and members of staff at BU and the RNLI as well as examining previous research and recent developments in design thinking and innovation. By drawing on these different sources, this paper aims to examine the problems and benefits of low resource design projects, and presents potential pathways for success in this field.

3 The Benefits

3.1 Educational stakeholders

Of course, the primary purpose for enabling such projects must be to benefit the student. In common with non-LRC design projects, the process should aim to expand the student's horizons, deepen their subject-specific understanding and broaden their skill base and experience, with the ultimate objective of enhancing their employability (Bournemouth University, 2017). In addition to this, however, LRC projects can include further educational benefits to the student.
Schaber's (2010) case study of University of Northampton's undergraduate project to design breadline shoes for Indian children stresses the benefit of exposing students to "socially responsible design and resourcefulness" in the face of severe cost/material/production limitations. The value of involvement in a real-world project with such life-changing opportunities is hugely attractive and beneficial to students, and this was recognised by our research correspondents who agreed that the experience of working alongside the RNLI was particularly rewarding.

As well as students, academic and technical staff also stand to gain from LRC projects. They offer a valuable opportunity to engage in real-world projects with commercial and international dimensions, and can help academics to build relationships with subject matter experts and organisations. They also raise awareness of current issues among staff, and the specialist knowledge garnered by students can filter through to academic supervisors to inform future projects.

Institutions can also reap many other benefits alongside the professional development of staff. BU's RNLI/Bottle Buoy collaboration enhanced the research profile of the faculty, improved the global profile of the University, and earned valuable and widespread publicity as a result of success at the IMRF Awards. BU's student LRC projects have regularly attracted attention at the annual New Designers exhibition in London, as well as the University's own Festival of Design and Innovation. The influence even extends to finances: BU is currently investigating the possibility of drawing on the potential benefits offered by the RNLI's funding model.

3.2 The wider context

Outside the academic environment, the primary beneficiaries are the target communities themselves, of course. The Bottle Buoy and two other devices - along with targeted community education - aim to have a significant effect on global drowning rates, with Bangladesh's shocking 18,000 child drownings per year as the initial focus. Such events have a devastating emotional and economic impact on the local and regional communities, and it is rare that a single product can hope to have such a wide-reaching and fundamental effect. The equipment items developed will now be contextually tested by the Centre for Injury Prevention and Research (CIPRB) in Bangladesh to ensure that communities will accept and use them for their desired function.

LRC projects have also been found to propagate unexpected additional benefits to local communities. One example resulted in the creation of possibly the first Bangladeshi custom surfboard design and manufacture business as a spin-off from the building of rescue equipment.

For the RNLI, alongside the increase in capacity for design projects which will ultimately allow them to achieve their stated objectives, working with students fulfils an important goal in engaging with local education practice and academia. RNLI engineer Rob Debbage acknowledges the importance of helping to nurture local talent in this way:

"The RNLI's direct engagement with students at a critical point in their development enables us to harness young talent and creativity, whilst raising awareness of our purpose and delivering key messages. Through student engagement, we hope to cultivate the future innovators in lifesaving."

It has also been found that Product Design students offer a perspective on design problems that is different from in-house design engineers. Career engineers used to working on boat-related issues tend to be restricted by constraints imposed on them by their subject-specific knowledge, whereas the breadth of projects that BU students tackle enable them to perhaps look at challenges in a more abstract and holistic way. Students also tend to offer a more human-centred design solution than technically-minded engineers.

From a more environmental perspective, the benefits of developing sustainable design solutions – from an ethical, social and economic point of view – have long been expounded by a huge number of researchers, of course, and many of these stress the importance of achieving sustainability through greater consideration for the local context (Elkington, 1994; Zurlo & Nunes, 2016). Vadoudi, Allais, Reyes and Troussier (2014), amongst others, encourage designers to shorten the supply chain by utilising "local resources for local use". Morelli (2013) also calls for designers to involve local institutions, service providers and individuals, and "to adopt a new paradigm of design to operate production and consumption processes".

4   THE CHALLENGES

4.1 Designing for unfamiliar communities

Aranda-Jan, Jagtap and Moultrie (2016) produced a "holistic contextual framework for guiding the design decision-making process" in a LRC context. Although this framework was specifically produced for medical products, it offers a useful breakdown of the factors that need to be recognised and assessed by designers working on any LRC projects. Alongside the issue of public health – which may be considered less of a priority for non-medical devices – it specifies seven distinct categories of factors:

- Socio-cultural (e.g. literacy, language, religious beliefs)

- Infrastructure (egg access to electricity and water, transportation links)

- Geographical/environmental (e.g. temperature, community remoteness)

- Institutional (egg availability of funding, government involvement)

- Economic (e.g. GDP, poverty level)

- Industrial (egg manufacturing methods, supply/distribution chain)

While some of this information – such as geographical factors and GDP – can be readily accessed online, many of these areas are at best difficult for students to analyse without heavy involvement from someone with first-hand knowledge of the target community. One former BU student specifically stated that "sourcing reliable information on local production techniques was particularly difficult". This lack of information can range from the likelihood of the availability of semi-industrial manufacturing methods to simple things such as whether the target community has access to tape measures and glue. He also found himself heavily reliant on RNLI links: "I feel that without the links to my target users I had via the RNLI, I would have been at a significant disadvantage". In particular, it may be extremely hard for a Western student to gain a comprehensive grasp of the full range of socio-cultural factors at play in remote LRCs. As one student put it: "I think the University expects a lot from students working on these types of brief, in terms of obtaining first-hand information from hard-to-reach markets/users".

4.2 Academic supervision

Low-resource projects can often involve communities and issues outside the usual parameters of educators' knowledge and experience. If tutors are unable to provide specialist knowledge on the specific issues – and potential range of solutions – for a project, this may well present a major cause for concern. In Bournemouth University's case, the Product Design final year has been developed around the ethos of problem-based learning (PBL). For many years debate has raged as to whether PBL is best supported by tutors who have a detailed knowledge of the problem area – so-called

content experts – and those who have relatively little knowledge – so-called content novices (Gilkison, 2003). A meta-analysis of previous research conducted by Leary, Walker, Shelton and Ertmer ([A1][A2][A3]2013) concluded that "content expertise is not a significant factor" in the success or failure of effective problem-based learning, a result which echoed the previous results of analysis by Park and Ertmer (2007). It may seem therefore that educators should not be concerned about a lack of specialist knowledge of low resource communities.

However, some evidence drawn from student experience suggests that students do value tutors' knowledge of the associated content, and lack of knowledge could therefore have a negative effect on students' morale and level of respect, even if the outcome is successful (Feletti, Doyle, Petrovic & Sanson-Fisher, 1982). Interestingly, the authors' own research with former students suggests that they may feel disadvantaged, or alternatively feel more empowered: "I was dealing with a market which perhaps few of my lecturers had first-hand experience in, and so [they] became more reliant on my first-hand information". Either way, it is conceivable that an inability to provide specialist help could be damaging to a tutor's own morale and confidence. BU is in a fortunate position, having access to academic staff with professional experience in LRCs, and it is debatable whether such projects would be so readily embraced without this.

4.3 Assessment

LRC student projects present academic issues alongside the practical difficulties. At BU design validation is a major factor in the assessment of final-year Product Design projects, and without relying on the opinions of outside experts it can be hard to ascertain whether the product offers a practical and appropriate solution to the defined challenge. It must be recognised that LRC projects are not alone in this; medical devices, for example, can present a similar challenge. For these kinds of projects BU therefore insists that students obtain professional validation for their final design.

There is an added complication when prototypes require assessment. At Bournemouth University, Product Design students' prototyping skills are assessed separately from the rest of the project, comprising an individual unit worth 20 credits. LRC products can on occasion be highly complex and involve substantial prototyping ability, but this tends to be the exception. More often the product is intentionally designed to be simple and easy to manufacture with comparatively low levels of skill. This can present major issues of parity with other students, most of whom are required to replicate precise, working products designed for Western manufacturing processes using their own manual prototyping skills. BU attempts to address this discrepancy in part by insisting on students using – as much as is practically possible – exactly the same materials and techniques as would be employed by the target producers; for example, using manual tools instead of machines. In addition, students with simple products are more heavily penalised for any inaccuracies in their prototypes. However, in the event of a student having no inaccuracies when a product consists of little more than a length of rope and some rough-cut wood, it can be hard to defend a prototyping

mark of less than 100% - a result which would be practically unachievable by students with non-LRC prototypes.

In order to further redress the balance and present additional academic challenge in these projects, BU also requires that some kind of accompanying document forms part of the product solution, and this is presented alongside the prototype. Usually consisting of a construction guide or information booklet, it is heavily scrutinised for its suitability for the given socio-cultural conditions, its use of semiotics and colour psychology, and the standard of presentation, amongst other things. In practice, this document can sometimes have a greater impact on the final grade than the accompanying artefact, and this may provide a bone of contention. It must be acknowledged that – although this has increased the level of challenge for the student – it is not offering a fully valid test of prototyping skill as such, but instead assessing the student's abilities with copy, layout, graphics and software such as Adobe InDesign and Illustrator.

4.4 Compliance

Modern effective lifesaving equipment is often designed to comply with relevant design and engineering standards. Although in a developed world context this would ensure that the product is fit for purpose, in a low resource environment, the RNLI's sustainable equipment project has discovered that compliance can make lifesaving products prohibitively expensive and therefore not accessible to the very communities that desperately need them. There is obviously a careful balance between the benefit of having non-compliant equipment and the risk that non-compliance poses. The RNLI's Engineering and Asset Management value stream newly developed FMECA (Failure Mode, Effects and Criticality Analysis) tool, named 'SHARK-DAT' is being used to mitigate this risk during design. This process, (originally designed for lifeboat design and manufacture) provides assurance and design verification of lifesaving equipment that falls outside of standards and regulations.

5   MORAL & SOCIAL ISSUES

The RNLI's International team are developing operational and educational interventions to prevent drowning in a number of low-resource regions. In Bangladesh it was found that there is a need for lifesaving equipment to support both education and rescue operations. The purchase of western designed and manufactured equipment is often not financial viable, sometimes because of unfair trading practices. Some life-saving equipment manufactured in South Asian countries by European companies is bizarrely shipped several thousand miles around the world before being resold to those same countries at a massively inflated price. Because of the high cost of this equipment it was discovered that native versions were being created from locally available materials. However the function and reliability of these devices were often compromised due to an apparent lack of understanding of the key functional requirements. The RNLI therefore initiated a project with the aim of providing appropriate instructions to local communities for the low-volume production of

equipment based on the locally available materials and manufacturing methods, but it was found that the product design skills and knowledge essential to create the best possible solution were not available in the local context. One of the authors - as programme manager of the project and also a lecturer in product design - saw the potential benefit of utilising UK undergraduate product designers to help with design solutions.

The question must be asked as to why countries like Bangladesh have become reliant on students on the other side of the world to design product solutions to local problems. Literature around design in Bangladesh is limited but does corroborate the anecdotal evidence found by the RNLI's programmes team. Banu (2009) cites a Design Without Borders report produced in 2003 that indicates a 'design deficit' and situates design in Bangladesh within the context of social development (Knutslien & Thommessen, 2003). He presents four factors that are missing from design in Bangladesh:

- Policy – No national or corporate-level design policy exists, and there is no national accreditation system.

- Profession – There is a shortage of local practitioners.

- Education – Alongside the shortage of design educators, the lack of any Masters-level course means that design research is virtually non-existent. Crucially, although Bangladesh's capital city Dhaka does have two universities that offer courses in Product Design, the focus is on training students to produce western-influenced designs intended for export rather than indigenous products that satisfy a local need.

- Definition – Bangladesh has no design identity and no engagement with modern design development. This breeds a lack of familiarity with design concepts and language, and consequentially design is regarded as a product rather than a process.

Public rescue equipment is not commonplace in Bangladesh communities and further research is required to find out if it will be readily accepted and used. In some instances communities are simply resistant to the relatively novel concept of making or purchasing equipment for public access for occasional use in the event of an emergency. In other cases, low resource products have been rejected because of superficial perceptions. Some early indications from research in the use of playpens to reduce the risk of 1-5 year-olds straying from home and drowning in nearby ponds has suggested that communities favoured the more expensive plastic versions to the cheaper wooden versions due to perceived social status – despite the fact that both products performed the same function equally well. In another example, one major rescue organization declined to use the low-resource version of a rescue product in favour of a similar product used by the RNLI. Again, both items perform the same function, yet the RNLI version costs almost ten times as much.

6   THE DESIGN PROCESS

As part of the RNLI's International Drowning Reduction Strategy, several items of low resource equipment have been designed due to need from communities. These items have been designed using the traditional engineering design flow, similar to that proposed by Ertas and Jones (1996). However, this process was created for linear design and does not allow for physical and cultural separation between the user and designer. It is also based on the final design being a physical product rather than an instruction manual that instructs a community member how to make that product in a sustainable way.

The knowledge and experience gained from previous LRC projects has enabled the authors to formulate a new design flow for low resource product development (Figure 3). This process integrates the traditional design flow with both agile and human-centred design (HCD) methodologies. This new design flow will be trialled over the next project period and will be updated and adapted as necessary.

There are also lessons to be learned from the small but growing band of designers, engineers and innovators springing up in some parts of South Asia. One example is Uddhab Bharali who is celebrated in India for his low-cost agricultural inventions and is now turning his skills to aids for the disabled (Rice, 2017). Bharali has produced over 140 inventions – some garnering international awards – using the philosophy of jugaad innovation. Jugaad, a Hindi term translated as "ingenious improvisation", represents a bottom–up approach to frugal and flexible innovation, and is increasingly becoming incorporated into design planning. LRC projects particularly stand to benefit from its six core principles:

- Seeking opportunity in adversity.

- Doing more with less.

- Thinking and acting flexibly.

- Including the margin.

- Following your heart.

- Finally - and crucially - keeping it simple (Radjou, Prabhu & Ahuja, 2012).

Developments in design thinking are increasingly having significance outside the design and engineering sphere. The RNLI is one of several organisations now using design thinking in organisation-wide development activities (Brown, 2009). The RNLI innovation and corporate planning departments have begun embedding these practices into strategic, tactical and operational planning.
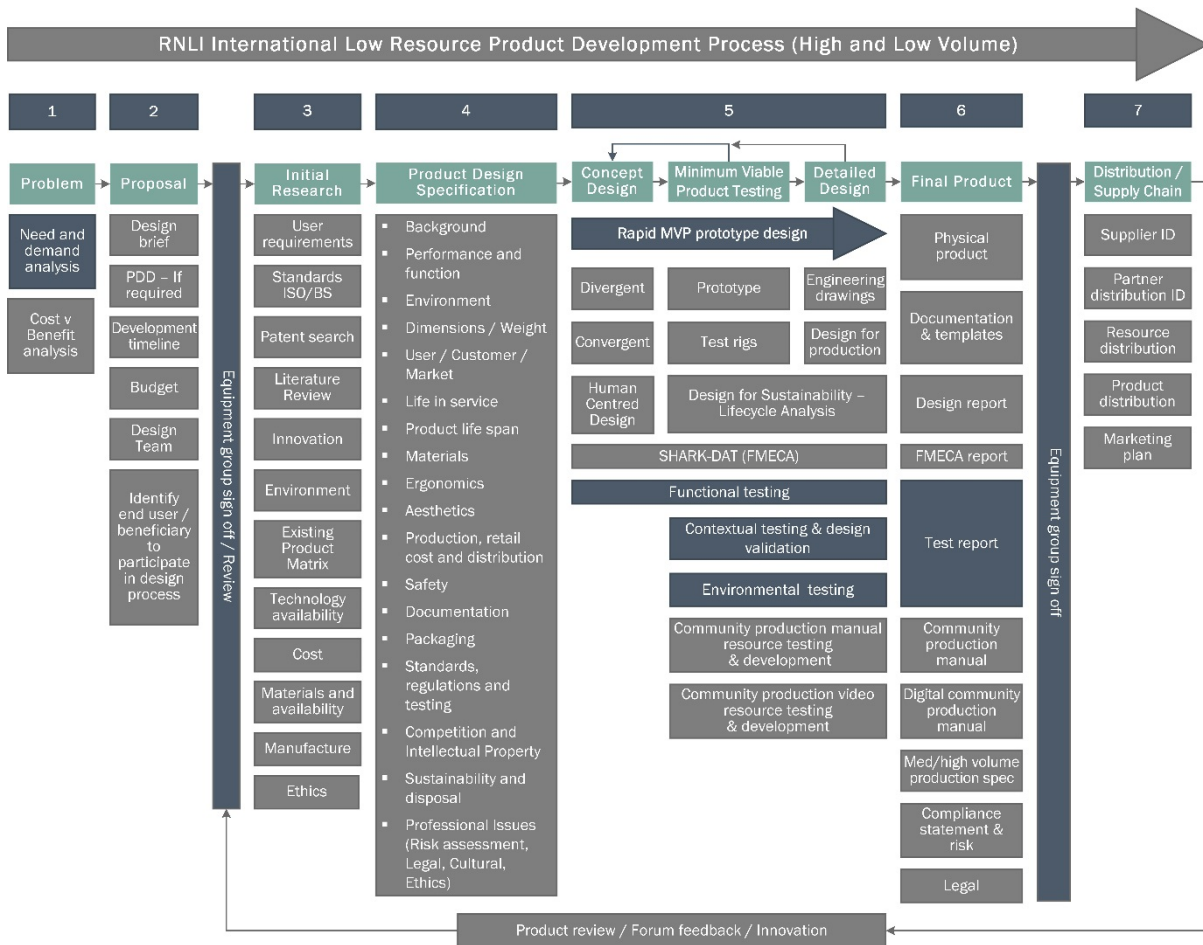
Figure 3

7   LOOKING TO THE FUTURE

7.1 A community of practice

The authors' research exposed the problems students face in trying to accrue comprehensive reliable information about LRC's. It would seem sensible that greater co-operation and knowledge sharing – between NGO's and academic institutions in particular – would make great strides in alleviating this problem. One student voiced the opinion that "it would be extremely valuable to students working on these briefs if the University and lecturers continued to build links with organisations working across the world. These links could be used to the students' advantage, as a means of helping them obtain first-hand information".

The RNLI are currently making moves in this direction, with a proposal to create Rescued by Design. This would be a central resource hub, a one-stop shop for accessing information and designs related to lifesaving equipment. This proposal builds on the concept of a 'community of practice', as proposed by Lave & Wenger (1991). The key characteristics of a community of practice are threefold: that it represents a joint enterprise with a common theme between members; that mutual interaction between members generates a social identity; and that a repository of pooled knowledge and resources is built up over time (Wenger, 1998).

Such communities of practice are currently in widespread use in areas such as education, agriculture and anthropology, and the authors believe that there is both scope and appetite to adapt the model to thematic areas within product design. Prior to BU's involvement, the original Bottle Buoy concept was originally created by a student at University of Huddersfield, James Benson, and it is only due to its chance discovery by the RNLI that BU was able to subsequently help in its development into the product currently being trialled. While there are undoubtedly issues to be resolved concerning IP and plagiarism, greater access to information amassed as part of prior design projects could help both students and NGO's develop truly appropriate solutions.

As well as offering a practical framework for discussion and the sharing of information around a common theme, communities of practice also provide an alternative method of education, termed 'situated learning'. As opposed to the internalised, academic view of education, 'learning as increased participation in communities of practice concerns the whole person acting in the world…[with] an evolving, continuously renewed set of relations' (Lave & Wenger, 1991). This could have added benefits in an area such as Bangladesh where shortfalls in design education and safety awareness could be addressed directly.

7.2 The global society

During a recent visit to Nigeria and Kenya, Facebook CEO Mark Zuckerberg visited a number of establishments helping to encourage local innovators and designers to develop their ideas, including Co-Creation Hub Nigeria and Kenya's Gearbox maker-space (Dubey, 2017). Gearbox offers access to training and facilities for designing and building prototypes, and fosters a community of technical experts, creatives, entrepreneurs and makers. Its creator, University of Nairobi lecturer Dr Kamau Gachigi, stressed during the 2017 TEDGlobal conference in Tanzania how important such spaces – and such communities – are, for helping local people to create solutions suited to their specific environment and circumstances, and for encouraging local practical skills and productivity: "We need many more people to develop their potential and contribute to society." (Wakefield, 2017)

MIT professor Clapperton Mavhunga also champions the establishment of local creative spaces in low resource societies, based on the innate traditions of cooperation and community as opposed to the Western predisposition for individual innovation (Mavhunga, 2014). Moreover, he proposes that the key to successful solutions is to encourage the fusion of formally educated, skilled expertise with homegrown wisdom and creativity. Whilst his message is mainly focused at inspiring African students to re-establish their links with their native communities, the core sentiment that "we should spread our net wide to embrace all of society in innovation" is supportive to greater wholesale collaboration across borders and backgrounds.

The rapid global spread of modern technology has made a massive difference in our ability to carry out low-resource projects. Email in particular has been a huge benefit in BU projects, allowing students and the RNLI to connect with remote and distant communities in a way that would have

been impossible a decade ago. It may seem surprising, but Bangladesh possesses more mobile phones – over 130 million - than most European countries (BTRC, 2016). Although smart phone ownership is relatively low at 8.2 million, this figure is set to expand massively over the next few years, and over 60 million members of the population are connected to the internet via their phones (Hussain, 2016).

The spread of the internet and mobile technology to formerly remote communities offers an immense opportunity for design students, academics and low resource communities to engage with global and local issues in a newly productive and meaningful way. Mark Zuckerberg recently offered his own view on the solutions that could be created:

"Our world is more connected than ever, and we face global problems that span national boundaries. Our greatest challenges also need global responses -- like ending terrorism, fighting climate change, and preventing pandemics. Progress now requires humanity coming together not just as cities or nations, but also as a global community." (Zuckerberg, 2017)

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