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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.

Keywords: Drowning, low-resource, RNLI, Bangladesh, Bottle Buoy, JUGAAD.

1 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; school furniture; and 'man overboard' recovery devices.
This move towards local production has been driven by BU's local links with the Royal National Lifeboat Institute (RNLI) in Poole. The RNLI is a charity that defines one of its long term strategic goals as to have "effective drowning prevention strategies in place in the highest risk areas internationally" [1], and a part of this strategy includes design of equipment suitable for low resource communities. While the RNLI's own engineering and asset management department have conducted work on suitable projects, live briefs for students were issued to enable extra capacity. The RNLI supports these briefs by offering access to technical experts, test facilities and users in target communities. 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 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. By drawing on previous research and new feedback provided by students and staff at BU and the RNLI, this paper aims to examine the issues and present potential pathways for success in this field.

2 THE BENEFITS

2.1 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 [2]. In addition to this, however, LRC projects can include further educational benefits to the student. Schaber's case study of University of Northampton's undergraduate project to design breadline shoes for Indian children [3] stresses the benefit of exposing students to "socially responsible design and resourcefulness" in the face of severe cost/material/production limitations. Echoing this, one BU student described the chance to be involved in a real-world project with such life-changing opportunities as "a rewarding experience".
As well as students, academic and technical staff also stand to gain from LRC projects. Aside from being directly involved in LRC-based research projects and commercial collaborations, the knowledge garnered by students can filter through to academic supervisors and inform future projects.
In addition, institutions can reap many 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.

2.2 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, working with students presents an ideal opportunity to help nurture local talent. RNLI engineer Rob Debbage acknowledges the importance of this:
"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 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 [4][5]. Vadoudi, Allais, Reyes & Troussier, amongst others, encourage designers to shorten the supply chain by utilising "local resources for local use" [6]. Morelli 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" [7].

3 THE CHALLENGES

3.1 Designing for unfamiliar communities

In 2016 Aranda-Jan, Jagtap and Moultrie produced a "holistic contextual framework for guiding the design decision-making process" in a LRC context [8]. This specified eight distinct categories of factors that need to be recognised and assessed by designers: socio-cultural; infrastructure; geographical/environmental; institutional; economic; public health; and industrial.

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 BU student specifically stated that "sourcing reliable information on local production techniques was particularly difficult". 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 on 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".

3.2 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 [9]. A meta-analysis of previous research conducted by Leary, Walker, Shelton and Fust in 2013 concluded that "content expertise is not a significant factor" in the success or failure of effective PBL [10], a result which echoed the previous results of analysis by Park et al. [11]. 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 [12]. Likewise, 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.

3.3 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. LRC products can be highly complex and involve substantial prototyping ability. More often, however, 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.
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.

4 MORAL & SOCIAL ISSUES

The RNLI's International team are developing operational and educational interventions to prevent drowning in a number of low resources regions. In Bangladesh it was found that there is a need for lifesaving equipment to support both education and rescue operations. As the purchase of western designed and manufactured equipment is not financial viable, it was discovered that local versions of this equipment was being created from local materials. However the function and reliability of these devices was often compromised due to an apparent lack of understanding of the key functional requirements. The RNLI therefore initiated a project to provide instructions to local communities for the low volume production of low-resource equipment, 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.
Literature around design in Bangladesh is very limited but does corroborate the anecdotal evidence found by the RNLI's programmes team. Banu [13] presents four factors that are missing from design in Bangladesh: policy, profession, education and definition, and 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 [14]. Crucially, although Bangladesh's capital city Dhaka does have two universities that offer courses in Product Design, their content is heavily skewed towards encouraging students to design for the export market rather than local need.

5 THE DESIGN PROCESS

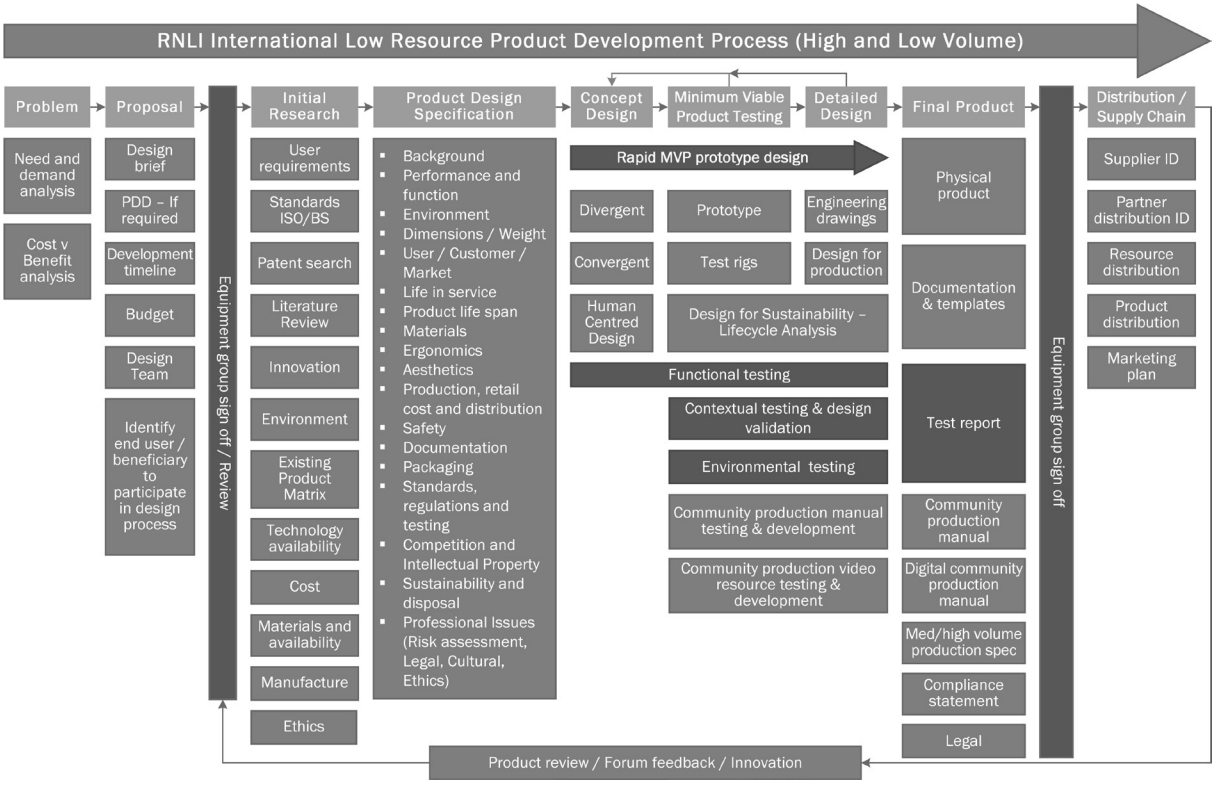

Figure 1

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 [15]. 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 1). 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.
The growing phenomenon of JUGAAD innovation - a bottom–up approach to frugal and flexible innovation – is also being 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; and – crucially - keeping it simple [16].
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 [17]. The RNLI innovation and corporate planning departments have begun embedding these practices into strategic, tactical and operational planning.

6 LOOKING TO THE FUTURE

The global drowning problem is huge. The World Health Organisation estimates approximately 372,000 deaths from drowning per year [18]. Much of the current thinking and practice in the drowning prevention community involves activity in education, influence, supervision and rescue, but in countries where drowning rates are comparatively low due to efficient drowning reduction activity there are still gaps in these approaches. In the UK the RNLI are now increasingly focussing on design and design thinking to further resolve the issue of drowning prevention.

6.1 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' (CoP), as proposed by Lave & Wenger [19]. Such CoP's 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.

6.2 The global society

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 [20]. 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 [21].

The spread of the internet and mobile technology to formerly remote communities offers an immense opportunity for design students and academics to engage with global and local issues in a newly productive and meaningful way. Mark Zuckerburg, CEO of Facebook, 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." [22]

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