The Challenges of Parachute Design: The Development of a Low Cost, Fit for Purpose Trauma Pack for use in Namibia

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Abstract: This paper presents lessons learnt and recommendations for future studies attempting to apply a parachute design approach to design for Namibia. The focus of this project is the development of a low cost, fit for purpose trauma pack for use in Namibia. The project was undertaken by an interdisciplinary team of medics, designers and engineers in an effort to reduce high mortality rates that occur as a result of road traffic collisions in Namibia. The pack was developed through applying a Human Centred Design approach that calls upon Design Thinking and end-user engagement. The key focus of the paper is a design development process that responded to key findings from user testing and design for manufacture requirements. The design was guided by the World Health Organisation's (2010) *Four A's*: Accessibility, Availability, Affordability and Appropriateness.

Keywords: Design Thinking; Human Centred Design; Healthcare; Namibia, First Responder; Trauma Care

Reference:

Biographical notes:

1 Background

This paper presents the development of a first responder (trauma) pack aimed at reducing the high mortality rates that occur as a result of road traffic collisions (RTCs) impacting Namibia. The development of this pack was based on previous research, and therefore background information is presented, including work completed on two previous packs. Much of what we learnt in the development of these two, very different packs eventually surfaced again in *The Namibia Pack.*

Between 2012 and 2016 an interdisciplinary team of researchers from the Cardiff School of Art and Design at Cardiff Metropolitan University and Cardiff University's School of Medicine, worked on a series of research projects which eventually resulted in the development of two low-cost trauma packs. An initial pack was designed for use in rural Zambia, (Watkins, 2016) and for the remainder of this paper it will be referred to as '*The Zambia Pack*'. The second pack, referred to as '*The European Pack'* was developed using findings from *The Zambia Pack*, to meet unmet needs of the European market.

The research material on which both packs were based was undertaken between 2012 and 2015 as part of Watkins' PhD (2016), exploring the potential for rapid ethnography-informed prototyping in enabling the development of medical product solutions in the developing world. Both packs were developed by the team as a whole and are intended for use by people with limited education and literacy (Zambia's secondary school enrolment is 42.9%) (UNICEF, 2019). The Zambia pack was designed to enable Zambian first responders to provide immediate response following a Road Traffic Collision (RTC). *The Zambia Pack* was proven to address a key factor identified as having an impact upon mortality rates in Zambia, i.e. the stabilisation, movement and transportation of post-incident victims. All the work described below is closely-related to broader Human Centred Design research work at Cardiff School of Art and Design and the Phoenix Project, an international collaboration between the University of Namibia and Cardiff University which at the time of writing, had successfully delivered 40 projects focused on poverty reduction, health promotion and environment.

1.1 Pack One – The Zambia Pack

The Zambia Pack was developed through a Human Centred Design (HCD) (ISO13407, 1999) process involving typical end users including untrained, unskilled, illiterate, rural dwellers as well as Zambian medical professionals and policy makers. Users were involved in three rounds of testing in Zambia, supplemented by a series of five UK testing rounds to solve basic issues prior to field trials. In total, 105 Zambian and 25 British users tested the pack.

The results from user testing were very encouraging. Scenario-based user testing in September 2014 found the pack to be very well-received and witnessed all 28 Zambian and 6 UK users successfully and efficiently using its contents. In addition, the solutions have been well received. In March 2014, at the direct request of medics, several elements from *The Zambia Pack* were left in the Chongwe District General Hospital, Zambia where they were subsequently employed in response to a 64-person RTC in April.

The components within the pack were designed to ensure adherence to the World Health Organisation's (WHO) (2010) four A's: Accessibility, Availability, Affordability and Appropriateness[1]. A critical facet of the design was that it was intended for manufacture *in situ* using freely available local materials and low-tech manufacturing processes to keep costs low, ensuring sustainability and lending a secondary financial benefit to the regions where it is employed.

1.2 Pack Two – The European Pack

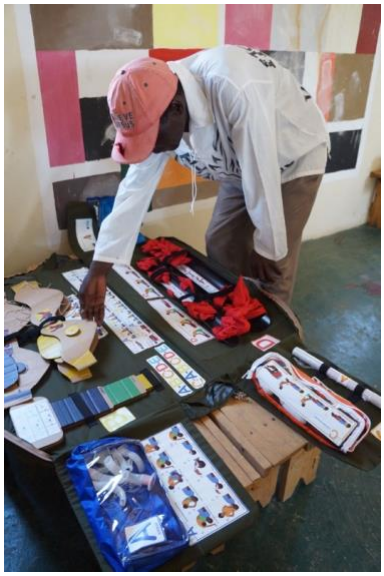
During user testing of *The Zambia Pack* in the UK, it was identified that beyond the benefits in Zambia, there was a potential for the pack to impact the European market. In response to these findings in September 2015, *The Zambia Pack* was presented to the Head Surgeon of the International Committee of the Red Cross, Geneva and his team. The team expressed great interest and recognised an ability to provide high impact through the development of a First Responder pack designed specifically for the International Federation of the Red Cross and Red Crescent Societies. Based on their requirements and in close consultation with the Red Cross and the British MOD, the team developed a solution to directly tackle their identified challenges, including financial constraints and

[1] 'Is it currently appropriate to the specific context?' (WHO, 2010)

lack of standardisation and usability to enable an organised delivery of first responder care. As a result of continued end user engagement, our solution was a fit for purpose, low-cost, First Responder pack intended for the European market.

Figure 1 *The Zambia Pack*, a multiple person, multiple use pack composed of cardboard cervical collars and drainpipe leg splints in user testing.

Figure 2 *The European Pack* Prototype, intended for single person, single use and including an 'adjustable' plastic cervical collar and leg splint.



These innovative packs (*The Zambia Pack* and *The European Pack*) aimed to provide first responders with intuitive, life-saving equipment and easy to understand instructions walking them through the globally standard ABCDE (Thim et al. 2012) sequence of care. User testing ensured that non-expert users were equipped to ensure stabilisation before transportation to hospital.

A key difference between *The Zambia Pack* and *The European Pack* lies in the radically different production economics and manufacturing realities of Western Europe and rural Zambia. While *The Zambia Pack* prioritised the use of low cost, low tech materials and manufacturing processes at the expense of high (and cheap) labour input, *The European Pack* was carefully designed to enable low-cost mass manufacture in the European context where labour costs are more likely to be a deciding factor. Developed with the British Ministry of Defence (MoD) input, *The European Pack* is about to enter production with BCB International.

1.3 Pack Three – the Namibian Pack

In August 2016, the research team were awarded funding from the UK Medical Research Council (MRC) to undertake a 15-month, early phase research study to examine the potential to apply findings from our previous studies in a Namibian context. This research built upon an already well-established collaboration between Cardiff University and the University of Namibia. The Principal Investigator (Hall) for this funding, a Professor of

Aesthetics, Intensive Care and Pain Medicine and Project Lead for Cardiff University's Phoenix Project had already successfully implemented 40 projects in the Namibian Context, and been working within Namibia for over 8 years.

The MRC study had three key objectives:

Objective 1: Assessment of *The Zambian Pack* and *The European Pack's* usability and appropriateness when applied to the Namibian context, followed by an iterative design development process to make the necessary adjustments to make sure the new pack was contextually appropriate.

Objective 2: The development of educational materials to enable identified first responders to be trained in the use of the trauma pack; and

Objective 3: Deployment of 60 packs in Namibia to assess their usability in real-life.

To enable effective completion of this project, the team was expanded to include key stakeholders from the Cardiff and Vale Health Board in the UK, the University of Namibia, Windhoek City Police and the Namibian Police Force. This paper presents key findings from Objectives 1 and 3.

2 The Problem

The problem being addressed in this paper is two-fold. Firstly the work described here relates to the WHO's Sustainable Development Goal 3.6, which aims to reduce global deaths and injuries from road traffic injuries by 50% by 2020 (WHO, 2017). The WHO (2017) reports that each day, globally over 3,400 people die on the road, and that each year tens of millions of people are left injured or disabled. Namibia's status as a Developing Country with an Upper-Middle Income (UN, 2017) led our team to believe that it was an ideal location for the study since it has both the problems associated with traffic deaths in the developing world and some of the financial wherewithal to address it.

Namibia has a population of 2,580,856 (Worldometers, 2021). RTCs are reportedly the ninth largest cause of death in Namibia (IHME, 2021). In 2019 the Namibian Motor Vehicle Association (MVA) reported an average of 302 crashes per month and 270 road casualties per 100,000 persons. 46% of injuries and 40% of fatalities were aged between 16 and 35 years; 64% of those injured and 70% of fatalities were male. This is a critical factor because it frequently means that the breadwinner of a family is killed or injured, which multiplies the effect of the problem (Chatukuta, 2020). The MVA (2019) reported a 5% increase in 'road crash fatality' between 2018 and 2019 with an annual fatality of 676 in 2019.

Secondly, this paper addresses some of the recognised challenges associated with undertaking design for a foreign context. Specifically, western designers working in low-resource environments and the potential for lessons learnt in one context (Zambia) being applied to another (Namibia). To support this, a review of literature was undertaken to better understand the project design and management.

3 The Literature

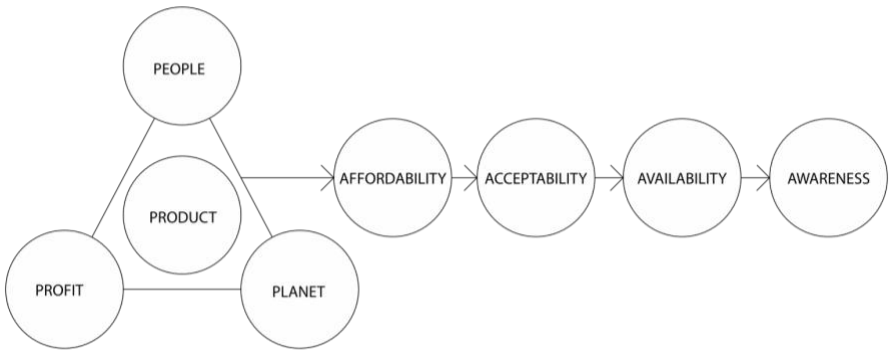
In 2002, Prahalad and Hart presented a concept called the 'Base of the Pyramid' (BoP), a phrase which refers to the two thirds of the global population that comprise the world's

poorest 4 billion people, living on less that $2 a day. Prahalad and Hart present the BoP as an untapped market accounting for 40-60% of all economic activity in developing countries, but suffering from an overall lack of resources. They argue that this market is 'wide open to innovation' and that it would make the 'ideal testing grounds for developing environmentally sustainable technologies for the entire world.' A similar approach is advocated by Hart and Christensen (2002) and So and Ruiz-Esparza (2012).

When analysing methods of designing for the BoP Diehl and Christiaans (2007) agree with Polak (2008), Papanek (1992), Peat (2008) and Schumacher (1973), who argue that the two most critical phases of development are the research that leads to the brief and the product's delivery. To achieve this Diehl and Christiaans proposed a framework that highlights the need to focus on a slightly different version of the four A's: 'Availability - addressing challenges of distribution, Affordability – addressing low-incomes and pay structures, Awareness – addressing limited media access and Acceptability – responding to socio-cultural dimensions.' Combined with the four P's of Design for Sustainability (D4S) as outlined by Crul and Diehl (2006): 'People (social aspects), Planet (environmental aspects), Profit (business aspects) and Product.' Diehl and Christiaans argue that, as a means to achieve successful product development for the BoP, it is essential that the four A's and the four P's are considered and accounted for. Diehl and Christiaans (2007) encourage engagement with the target user and local context, enabling clearer understanding of both the context of use and the end user.

Despite the recognition of the existing methodologies' ability to assist in the development of contextually appropriate technologies for the BoP, Diehl and Christiaans (2007) also recognise the prominence of their emergence from industrial markets and highlight a need for greater understanding of their ability to be adapted to the developing country context - an aspect also identified by Donaldson (2006), Hussain (2012), Puri (2004), Putman (2009), Shen et al. (2006) and Winschiers (2006).

Figure 3 '4 A's and 4 P's' Redrawn from: Diehl and Christiaans, 2007.



Donaldson (2006, p.22), argues that when designing for Less Industrialised Economies (LIEs)[2] it is 'imperative that design process be consistent with local conditions and be user-centric in approach.' Donaldson argues that Western designers often 'take short-cuts because of the perceived lack of complexity in finding a "solution", resulting in adaption of existing solutions that present an effective and cost-efficient solution.' Donaldson (2008, p.18) presents inefficiencies in the popular process of 'design for development', which sees western designers embark on short-term projects where they design a product for developing regions in their spare time, deploy in and then leave. Donaldson (2008, p.2) argues against remote design (design from afar) and parachute design (design from afar with visits) stating that such approaches fail to account for 'sense of culture, language, norms and deep understanding of the problems people face.' She highlights designs for LIEs receive a lack of criticism, resulting in awards being given to designs that have not been rigorously tested with end users in the intended environment of use. Donaldson quotes Smaili (2002) who argues in favour of culturally specific methodologies, with clear understanding of the constraints and opportunities in LIEs.

To overcome the challenges of designing products for developing countries, a number of user-centric design methodologies have been employed to facilitate the development of appropriate solutions designed specifically to meet the needs of the end user. These include Participatory Design (Hussain, 2012) a 'user-oriented' and 'human-centred' process that involves the end or potential users as co-designers, who play a critical role in the design process (Gregory, 2003). Human Centred Design (HCD) (Malan, 2019) is an approach that generates solutions to identified problems and opportunities (ISO13407, 1999). Solutions developed using HCD methods tend to respond to the needs, desires and context of the end users (Institute, 2012). Design Thinking (Brown and Wyatt, 2010) is an approach that draws upon HCD to integrate the needs of people with the possibilities of technology and potential for business success (Brown, 2009). In 2009, IDEO were funded by the iDE to develop a free innovation guide for social enterprises and NGOs worldwide, the result was the HCD toolkit (iDE, 2021). The processes used by IDEO in their HCD toolkit (IDEO, 2009, 2015) originate from the fundamentals of HCD and draw upon Design Thinking as outlined by Brown (2009).

Gould and Lewis (1985, p.300) argued that 'Any system designed for people to use should be easy to learn and remember, useful, that is, contain functions people really need in their work, and be easy and pleasant to use.' To achieve this, they present the need for Early Focus on Users and Tasks; Empirical Measurement; Iterative Design.

> *'First, designers must understand who the users will be … Second, early in the development process, intended users should actually use simulations and prototypes to carry out real work… Third, when problems are found in user testing, as they will be, they must be fixed. This means design must be iterative: There must be a cycle of*

[2] 'LIEs refer to those with low capacity to design and manufacture original products. Many of these economies are located in the low latitudes of Africa, Asia and Latin America.' (Donaldson, 2006).

> *design, test and measure, and redesign, repeated as often as necessary.'* *Gould and Lewis (1985, p.300)*

This approach is supported by Norman (1998) who argued that products can be developed to meet the needs and interests of the user, and which are usable and understandable, through the application of a user-centred design process.

Brown (2009), argues that as a means to meet the global challenges of health, poverty and education we should apply a process of Design Thinking, an exploratory, iterative and non-linear process based on HCD. This process comprises three overlapping non-linear spaces: inspiration, ideation and implementation, applied by an inter-disciplinary team. The inspiration stage involves using ethnographic research methods to listen to and understand the needs, desires and dreams of the people you wish to affect. During ideation, information is synthesised into insights that can lead to solutions and opportunities, which are then generated, developed and tested, ready for the implementation. In Stage Three, the solutions are implemented within society as prototypes where they are analysed to restrict error and retain high levels of sustainability and functionality.

Brown (2009) identified the benefits that can be gained through low-fidelity, creative prototyping and the use of scenarios to act out the solution in the context of real life, enabling observations to be made on the users' interaction with the prototype – a process capable of providing insights into a person's emotional response to the potential solutions, coined 'an experience blueprint.' Brown and Wyatt (2010) identify inefficiencies in many 'design for development'[3] projects, which fail 'to consider the cultural needs of all the people living in the community.' Reasons they identify for these omissions include a lack of consideration given to the needs of the end user, prototyping and user feedback. Brown and Wyatt argue that Design Thinking goes beyond traditional design approaches, using rapid prototyping and consumer insights to deliver solutions and infrastructures that meet the needs of the people.

In 2017, on recognition of a number of public health projects utilizing HCD and / or design thinking, Bazzano et al., undertook a scoping review of current research.

> *'The scoping review identified a number of documents describing the use of HCD for health, but also revealed pervasive gaps in both published and unpublished literature, especially related to replicable methods, description of methodologies used, evaluation of effectiveness or impact of HCD projects on health, and lifespan of design thinking projects along with potential for scale up of these initiatives for health.'*

[3] Design for the developing world

The methodology chosen for this study, and the structure applied, aims to respond to the findings from the literature. Specifically, it aims to gain insight into the impact of western designers' use of user-centric methodologies within a foreign context and their potential to provide understanding of the local context and target users. Acknowledging findings from Bazzano et al. (2017), that 'More rigorous evaluation of HCD as it applies to health in the future will allow for more acceptance and integration of design into health research, and ultimately the improvement of health projects through design thinking', the study calls upon user-centric methods as outlined by a number of sources, but with a focus on HCD and Design Thinking.

4 Project Design

As presented in section 1.3, this work forms part of a wider project funded by the UK MRC. As a result of the funding, the project was restricted by a set budget and timescale. Given these constraints the study adopted a parachute approach, whilst being aware of the literature's criticism of well-intended western projects aimed at the developing world and the need for a user-centric approach. In addition to this, whilst this study combined a process of HCD that calls upon design thinking, as outlined by IDEO (2009, 2015) and Brown (2009), it is important to note, the objective of the funding was to assess the potential to apply an already established concept, the 'trauma pack', to a new context. Therefore, unlike traditional approaches to design thinking and HCD, the project starts with an existing concept and builds upon previous findings undertaken by the research team (Watkins, *et al.*, 2014) (Watkins, *et al.*, 2015).

The project was based in Windhoek, Namibia and was undertaken by an interdisciplinary team with medical, technical, design and commercial backgrounds. In response to recommendations from Papanek (1992) who highlights the need for co-operation between developed and developing nations, and Polak (2008) who highlights the need to gain understanding of the problem, end users and context of use, the project was carried out in close collaboration with the Namibian Police force and the University of Namibia.

The study adopted an iterative, non-linear process of 'Inspiration, Ideation, Implementation' (IDEO, 2015) with an emphasis placed on the use of prototyping and user feedback (Brown, 2009). Synthesis focused on identification of WHO's (2010) 4 A's and Crul and Diehl's (2006) 4 P's.

4.1 Ethics

Prior to embarking on the study, in partnership with the Republic of Namibia Ministry of Health and Social Services and the University of Namibia, the team successfully applied for ethical approval from: Cardiff University, Cardiff Metropolitan University, The Republic of Namibia Ministry of Health and Social Services and The University of Namibia. Ethics covered all stages of the methodology, including user testing and implementation.

4.2 Stages

The key stages of the study are described below. Stages 3 and 4 were applied iteratively to enable the development of solutions that met the criteria established by Gould and Lewis

(1985) 'easy to learn and remember…' and Norman (1998) '…usable and understandable'. This also aligned with the 4 P's, 'People'.

Stage 1, Inspiration and Ideation

The Zambia Pack and *The European Pack* were initially evaluated. Inspiration was sought from the PI's experience of working in Namibia and a process of ideation was undertaken to allow a new pack to be developed. The new pack (the demonstrator pack) combined key design elements of *The Zambia Pack* and *The European Pack* which presented the potential to meet the requirements of the Namibian context. This pack was used as a tool to initiate conversations and gauge interest from key stakeholders, it was not intended as a final design.

Stage 2, Inspiration

In February 2017 the primary designer (Watkins) on the project embarked on a 5-day contextual study. This was her first experience of Namibia. This aligned with steps one – three of Polak's (2008) 12 steps to Practical Problem Solving – '1. Go to where the action is; 2. Talk to the people who have the problem and listen to what they say; 3. Learn everything you can about the problem's specific context.' To achieve this the study used observational techniques, conversations, interviews and focus groups as outlined by Sommer and Sommer (1991) and Kuniavsky (2003).

Stage 3, Ideation

3.1 The interdisciplinary team was expanded to include UK medical professionals with experience of working in post-trauma medicine. The newly expanded team synthesised the findings from stage 2 to identify key insights, opportunities and generate ideas, with a focus on the potential impact of the 4 A's and P's within the Namibian context. These insights in turn informed stages 3.2 and 3.3.

3.2 This stage of the process primarily focused on the development of prototypes that could be tested in Namibia. This stage of the process was extensively supported by BCB International who supported the need to ensure manufacturability and retain the lowest cost possible.

3.3 In recognition of the intention to provide training with the packs, testing was undertaken in collaboration with the training being provided by the education team and involved 217 typical end users interacting and providing feedback on the pack. These comprised of: 116 Namibian Police Officers, 93 Windhoek City Police Officers, 4 Red Cross workers, and 4 Emergency Crew Technicians from the Namibian Ministry of Health.

3.4 On completion of each round of user testing, the findings were analysed by the interdisciplinary team, facilitating an iterative process of ideation, prototyping and user testing. Analysis focused on whether the prototypes were utilised as intended, considering factors such a learnability, how many attempts the users took, and whether components within the pack were successfully identified and employed. A key element of analysis was on the adequacy of the level of care provided, this was assessed by the medical members of the team.

Stage 4, Implementation

To assess the pack's usability when deployed in situ, a comprehensive data collection system was developed with the support of the Namibian and Windhoek City Police. This included a method of distributing the packs to locations of interest; a method of signing the

packs in and out to track their location; and a post-usage questionnaire available as both an app and booklet. Each pack was distributed with:

- An instruction booklet
- A data collection booklet and/or phone
- a sign in/out booklet

To support the parachute approach, two Namibian Research Assistants were recruited by the University of Namibia, and were actively involved in stages 4-7. Whilst the UK team were out of country the RAs supported data collection and deployment. In addition, three police officers (one from Windhoek City Police and two from the Namibia Police) were recruited to support implementation.

4.3 Participant Selection

The team set themselves three objectives to enable the efficient deployment of the packs. In doing so the team targeted appropriate alignment with HCD and Design Thinking requirements for the incorporation of users throughout the design process.

Objective One: Identify an appropriate participant base.

Stage 2, Inspiration identified Namibia's police officers as typical RTC First Responders. Data collected from Police Headquarters found that at the time of the study there were 772 Police officers within Namibia, 472 of whom were based in Windhoek City Police. Of these, the Deputy commissioner identified 500 officers as being most likely to respond to trauma incidents within Windhoek, these being comprised of a mixture of Windhoek City and Namibian Police service officers. Namibia's Motor Vehicle Association (MVA), the Namibian Red Cross and the Namibian Ministry of Health were also identified as key stakeholders.

Objective Two: Ensure the accessibility of participants for user testing. During stage 2, the team contacted the Namibia's MVA, the Namibian Red Cross, the Namibian Ministry of Health, the Namibian and Windhoek City Police to arrange meetings and presentations on the project. This process was key to gaining the support of the stakeholders and access to Namibia's typical First Responders.

Objective Three: The development of training. Full first responder training with the packs was offered to all participants in the study.

5 Findings

5.1 Ideation: August 2016 – February 2017

In preparation for the stage 2, inspiration the team used their collective understanding of post-trauma treatment and the Namibian context to design a pack that combined the key elements of *The Zambia Pack* and *The European Pack*. Evaluation was undertaken by applying the WHO's 4 A's: Material selection and production methods were analysed to ensure Availability, Accessibility and Affordability, while understanding probable contexts of use and likely end users informed the Appropriateness. Crul and Diehl's (2006) 4 P's were also applied, with a focus on the end user responding to People and material selection and manufacturing processes selection reflecting consideration of Planet and

Profit. This pack was designed prior to visiting Namibia as a tool to aid discussion and access key stakeholders. It was not intended that this pack be used as the final concept in Namibia. This process of evaluation continued throughout the design process.

Figure 4 *The Demonstrator Pack*, a multiple person and multiple use pack with removable instructions.

Unlike either *The Zambia Pack* or *The European Pack*, Pack Three (*The Demonstrator Pack*), was designed from the outset as both a multiple person and multiple use pack. This reflected key findings from the Zambia study, including a tendency to re-use items intended for single use, as well as a need for easy transportation and protection for the pack's components in the extreme weather conditions sometimes prevalent in Zambia and Namibia. Research also identified that RTCs typically involve multiple victims meaning treatment would be required for multiple patients. The pack was designed to guide first responders through the global standard sequence of care (Airways, Breathing, Circulation, Disability, Exposure), providing ease of access with removable pictorial instructions, similar to those used in *The Zambia Pack* and *The European Pack*. Pack Three contents also reflected findings from previous studies, where components were categorised to align with the needs of the sequence of care and included: a range of oral airways (A), three sizes of cervical collars (small, medium and large) (B), a plastic wrap for burns (C), high pressure bandages (C), leg and arm splints (D), plastic blankets (E) and stretchers (E). These items were enclosed in an easy to access, portable pack which doubled as a stretcher. While a number of components were borrowed directly from *The Zambia Pack*, others were completely redesigned. For example, to meet the anticipated demands of the Namibian market, *The Zambia Pack* leg splints were further developed to reflect their multi use intention, with fabric straps being replaced with more robust and easily reusable webbing and buckles. In addition, a new set of cervical collars were developed which combined elements from both *The Zambia Pack* and *The European Pack*: the same materials as that of *The European Pack*, but the same interaction design principles as that of *The Zambia Pack*.

As with other aspects of the design, the design development of each cervical collar was undertaken using both the 4 A's and the 4 P's. The cervical collar developed for *The Zambia Pack* was made from low-cost readily available materials in the Zambian context, but the manufacturing process was labour intensive (an advantage when labour is cheap and you wish to encourage employment in the developing context). The Cervical Collar developed for *The European Pack* utilised low-cost, easily accessible materials and manufacturing processes in the European context. The new cervical collar design, developed for the Namibian context recognised both Namibia's high cost of labour and

capacity for large-scale manufacture, and also adopted the key interaction design elements included within the Zambia collar.

Figure 5 The Cervical Collar used in *The Zambia Pack*, made from corrugated card, string, and zip ties, screen printed and coated with bees wax.

5.2 Inspiration : February 2017

Watkins engaged in a five-day contextual study to gain insights into conditions in Namibia, gain support for the project and identify typical end users and key stakeholders. The pack from Stage One (Ideation) was used as a tool to initiate conversations and gauge interest from key stakeholders from the University of Namibia, Windhoek City Police, the Namibian Police, and the Namibian Red Cross.

Figure 6 Meeting with Windhoek City Police.

Conversation with the MVA identified Windhoek as the most appropriate location for the field trials in the next phase. According to the MVA Windhoek reports 43% of all registered vehicles and 53% of crashes (MVA, 2019).

The findings from this contextual study were synthesised in accordance with Design Thinking's three lenses: Viability, Feasibility and Desirability (Brown, 2009) and with a focus on the 4 A's (WHO, 2010) and 4 P's (Crul and Diehl, 2006). These findings were then used to compose a revised brief :

> *'To design a low-cost Trauma Pack capable of treating victims of road traffic collisions (RTCs). The solution should be suitable for use by typical first responders, identified as members of either the Namibian Police Force (NamPol) or Windhoek City Police (CityPol).'*

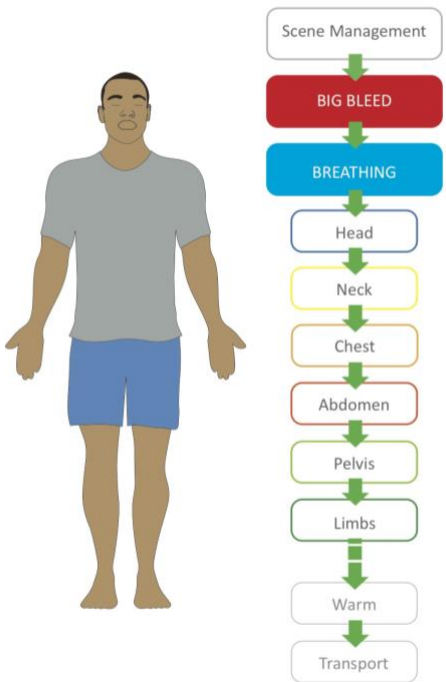
Figure 7 Location of Windhoek in Namibia.

5.3 Ideation and Creation: March – May 2017

On return from Namibia the interdisciplinary team was expanded to include two Anaesthetists from the UK and an Emergency Physician from Malaysia (working in the UK). The key role of these members was the development of an educational programme capable of training the Namibian Police Force, the Red Cross and Emergency Crew Technicians in post-trauma care.

During this process the team elected to change the ABCDE protocol, instead adopting a new algorithm that aligned with the British Military of Defence's Battlefield Advanced Trauma Life Support: CABCDE (Hodgetts, *et al.,* 2006). The new proposal offered an easy-to-understand head to toe approach (figure 8). In response to this development, the Namibian pack was re-developed to include: gauze, bandages, and tourniquets (Big Bleed); size 5 and 6 airways (Breathing); small and large cervical collars (Neck); chest seals, fabric tape; plastic wrap (Abdomen); pelvic binder, (Pelvis); splints (one size), (Limbs); plastic blankets (Warm) and; stretchers (Transport). Graphics were developed following the style already validated in both Zambia and the UK *(unpublished observation)*.

Figure 8 Big Bleed, Head to Toe Algorithm.



With the support of BCB International, the demonstrator pack was reverse engineered to incorporate lessons learnt in the development of *The European Pack* for production, and so reduce cost and improve reliability. As part of this process, a number of key design changes were made, including: replacing the original, custom designed high-pressure bandages that had been developed for manufacture in Zambia with an existing mass manufactured product; redesigning the stretcher to reduce material use; reducing the quantity of material used on the bag, and; replacing large removable instructions with a printed instructions booklet. On advice from the team's medics, the full set of oral airways were replaced with two sizes, small (size 5) and large (size 6), while the three sizes of cervical collars were replaced by two sizes (small and large). The resulting pack contained enough equipment to treat 3 – 5 people (depending on the extent of injuries).

Figure 9 Pack four.

5.4 Testing and Analysis : May 2017

Further user testing and design development took place during a 14-day period in late spring 2017 when an interdisciplinary team of designers and medical professionals embarked on the first round of in-context user testing with what at that time the authors assumed would be the typical end users. For testing purposes, six of the newly refined trauma packs (pack four) were manufactured and shipped to Namibia. A training programme 'FIrst Responder Support in Trauma (FIRST)' was developed to support the implementation of the packs. Testing was timed to be synchronised with the delivery of pre-arranged trauma training.

During the study, 192 typical end users (see below) (107 week one, 85 week two) tested the packs using a scenario-based user test that involved users being presented with the ideal method of deploying the pack in a given scenario. After a week of observing the testing, the team reflected on the lessons learned and iteratively developed the pack design further, applying the modified designs during the second week of scenario testing to observe the efficacy of the modifications.

The scenarios themselves were chosen to reflect common Namibian incidents. One scenario was presented during teaching and then students were tested on six further scenarios. To assess student performance the teaching team developed a best-case scenario response that provided a bench mark for best practice. For example:

SCENARIO 4

A middle-aged man driving a car has hit another car from behind. He is still in the driver's seat, not moving.

Key findings:

The patient has ongoing bleeding from a left arm wound; he is not talking but is making groaning noises.

Key interventions:

Movement of patient to place of safety; x2 pressure dressing to left arm wound + application of tourniquet; the patient is not talking but is making groaning noises and he will not open his mouth for insertion of the mouth airway - the candidate therefore performs a jaw thrust and the patients breathing then becomes normal.

SCENARIO 5

An elderly woman has been hit by a car. She is lying in the road; her left leg is deformed and she is shouting at you to help her with her leg.

Key findings:

The patient has ongoing bleeding from a wound of her neck; she has not walked since the accident and is unable to walk; her left leg is badly deformed.

Key interventions:

Movement of the patient to place of safety; x2 pressure dressing to neck wound; DO NOT apply neck collar; application of pelvic splint; application of left leg splint + use of tourniquet around ankles to keep legs straight.

As mentioned above, close observation of the performance of various components during user testing led to a range of design modifications which were then re-tested with a new set of participants. Some of the changes are described below.

5.4.1 The Splint Design

During the first week of testing key usability challenges were identified with the splint design. The original design required the user to apply two splints, one to either side of the leg. These were then fastened in place with the use of webbing straps and buckles.

Figure 10 The original splint design (pack four).

User testing identified key challenges:

1. There were too many straps and they were very long causing mess and confusion;
2. Because all the straps were the same colour, it was difficult to differentiate which was intended to join to another;
3. Users found it difficult to pass the buckles from one side of a patient's leg to the other.

In response to these findings, new materials were sourced from local wholesalers and in-context iterative design development was undertaken.

The new splint design replaced webbing and buckles and employed stretchy fabric straps of two distinctly different colours (blue and orange), which could be tied in place – a solution that had previously performed well in *The Zambia Pack*. The resulting design significantly reduced cost through the removal of 8 buckles (£4) and a reduction of strap length due to the elasticity of the fabric. In addition, the revised splint slightly reduced weight and the removal of the clips improved stacking, thus reducing the overall size of the pack.

Revised splints were then tested during week two with 85 new participants with much improved results. In the first week of testing only 22% (n:19) of users were able to effectively apply the splints (with effort). All users (100%) correctly and appropriately applied the revised splint design with ease during the second week of testing.

Figure 11 The Revised Splint Design.

5.4.

Within pack four users were provided with two cervical collars, one small (white) and one large (blue). User testing (figure 12) highlighted key challenges with the existing design:

1. Users struggled to identify the chin rest;
2. The foam holding the chin rest in place got in the way during the fastening process;
3. The width of the collar was frequently insufficient;
4. Users failed to fasten the collar securely in place;
5. It took users between 1 – 5 minutes to read the instructions.

In response to the highlighted challenges, the design was changed in three key ways:

1. The chin rest had been designed with a connecting strip between the rest itself and the fastening button, the intent being to hold the collar in its final position and enabling identification. The design was altered to remove this connecting strip of foam, increasing accessibility to the fastening button;
2. The blue and white collars were alternated so a white collar presented a blue chin rest and vice versa, more clearly indicating the chin rest;
3. The instruction booklet was reduced in length and the front cover showing the intended final position of the collar was attached to the collar instead.

Figure 12 Testing the Original Collar Designs.

Revised collars were re-tested during the second week of the study on 85 users identified as typical end users. The limited facilities available in the field meant that not all of the issues were resolved. However, findings suggested the modifications had nevertheless led to a significant increase in usability. Users were observed correctly identifying the chin rest with increased regularity and using the image of the application as guidance. In addition, the fastening process was significantly improved. Following revisions, 95% of participants (n:81) were able to correctly identify and apply the collar; a significant improvement from the week before 40% (n:34).

Figure 13 Testing the Revised Collar Designs.

5.5 Reflections, Ideation and Creation: June – August 2017

Upon completion of user testing in Namibia, the findings were evaluated and a human centred process of iterative ideation and creation took place in the UK to enable the development of a new fit-for purpose pack. As part of that process, a review of contents in light of user testing trials led to the inclusion of gloves (Big Bleed), tongue depressors (Breathing), foam blocks (Head), scissors (Chest), and space blankets (Exposure). Further design changes to three aspects of the pack are described in detail below.

5.5.1 The Cervical Collar

On return to the UK, an effort was made to tackle the design changes required to further improve the collar. This included addressing:

1. Users' ability to securely fasten the collar using the existing string tie method (figure 15);

2. The collar's sizing was incorrect for the context of use, because Namibians tend, on average to have significantly shorter, wider necks than European or Zambian users;

3. The current design presented specific weaknesses in the design, resulting in breakages - as shown in figure 14 and 15, the collars are made from a combination of corrugated plastic and foam. In order to allow flex in the plastic, a series of slits were strategically cut into the top layer of the plastic corrugation. Unfortunately, following repeated flex, the single layer that was holding the collar together would rip and split the collar into two or more parts. In addition, the low density of the foam resulted in tears forming around the rivets holding the materials together (figure 15).

Figure 14 Testing the Cervical Collars functionality

Figure 15 Testing the Collars functionality.

With the support of BCB International the team made a series of design changes to improve fastening, fit and weaknesses:

1. A new collar size was created to better reflect the anthropometrics of the Namibian population;
2. The string was replaced with Velcro to ensure secure application;
3. The corrugated plastic was replaced with 'bubble board', and the density of the foam increased to improve longevity.

In addition, upon recognition of the discovery in the field that the support was no longer needed for the chin, the foam was cut from one piece instead of the original two, reducing cost and manufacture time. Unfortunately, in an effort to retain a low cost, the design revisions removed the ability to have a separate colour chin area, which had shown to be beneficial in user testing.

5.5.2 The Revised Pack

Another key finding of the study regarded the usability of the bag itself and the accessibility of the components stored in it. Testing uncovered key issues:

1. Items within the pack fell out of their compartments during transport;
2. Items stuck to the pack's Velcro during use;
3. The pack easily became disorganised through use, limiting its usability;
4. The pack's form limited the ability to stack and therefore conveniently transport packs, and;
5. The pack was difficult to fold up correctly after use.

Figure 16 Pack four during testing.

In response to these findings from user studies, a process of ideation was applied to develop a new, compartmentalised solution that encouraged easy access, transportation, organisation and use. The new solution was in the form of a corrugated plastic box, with eight individual compartments (figure 17). The box enabled easy transport due to its stackable design and presented a low-cost, easy-to-manufacture alternative to the existing bag design.

Figure 17 Low-fidelity, rapid prototype of new pack design (pack five).

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corrugated plastic, a versatile material which would provide water resistance and durability. Unfortunately, the low volume required resulted in high production costs, and a need to manufactured the boxes from cardboard instead of corrugated plastics, however, all other factors presented a true reflection of the intended final concept.

Figure 18 Pack five, the final design.

Contents:

Big Bleed	3 x Tourniquet 3 x Large Dressings 3 x Medium Dressings 3 x Small Dressings 2 x Gauze 6 x Gloves
Breathing	3 x Female Airway 3 x Male Airway 3 x Tongue Depressor
Head	-
Neck	5 x Neck Collar
Chest	1 x Pack of Chest Seals 1 x Fabric Tape 1 x Scissors
Abdomen	1 x Plastic Wrap
Pelvis	3 x Pelvic Binder
Limbs	5 x Splint
Transport	3x Stretcher
Warm	3 x Blanket

5.6 Testing the Final Design: August 2017 – 14 days

The pack was re-tested in Namibia over a 14-day period following the completion of the design review and with the aim of ensuring the pack's usability before distribution.

During this round of user testing, re-developed packs were tested by 160 users, using scenario-based user testing methods and a 'Think Aloud Protocol' (Yen and Bakken, 2009). These tests confirmed that users were able to successfully apply each component of the pack with ease.

Figure 19 Testing the revised collar

5.7 Implementation: October 2017

In October 2017, 60 packs were manufactured and shipped to Namibia where they were distributed for use by the Namibian Police Force and Windhoek City Police. The aim of the study was to collect data on the real-world use of the pack in context: each officer was given a pack which was to be stored in the boot of their police vehicle. All the officers equipped with a pack had already been trained in its use. The intention of the trial was to monitor what actually happened in use.

Figure 20 The Pack Five ready for shipment

5.8 Mid-study Assessment: March 2018 – 5 days

In response to a significant lack of data received (6 uses) from the use of the deployed packs (pack five), the interdisciplinary team returned to Namibia to assess the current status of the project. During the trip the team met with key stakeholders and held focus groups with users from both the Namibian Police force and Windhoek City police. This resulted in a number of key findings, many of which directly contradicted the findings from the contextual study and user testing. For example, in direct opposition to previous findings, it was found out at this stage that the police were not typically first responders. In fact, first responders tend to be either passers-by or recovery trucks - the post–incident recovery business in Windhoek being very competitive, resulting in recovery drivers having really quick response times. Ambulance response times within the city are also typically quick.

The focus group identified that in real-life scenarios the police struggled to use the pack at the scene of the accident due to the priority being scene management, resulting in a lack of time to treat patients at the scene.

The focus group highlighted a lack of confidence and willingness amongst the Police officers when it came to treating injured parties. An interesting finding, as it directly contradicted earlier claims. All of the 192 participants involved in section 5.4 were asked to complete comprehensive feedback sheets at both the start and finish of the training course. Prior to the start of the course, 68 of the 192 participants stated that they were *not at all confident* in treating a victim of a RTC, 48 felt *not confident*, 23 *confident* and 11 *very confident* (42 candidates did not answer). After completing the course, no candidates felt either *not at all confident* or *not confident* in treating victims of RTCs, 45 felt *confident*, and 107 felt *very confident* (42 candidates did not answer). Candidates were also asked whether there were any items of the training or trauma pack which they felt unsure about, 150 reported not and 5 reported in the affirmative (37 did not answer).

The distribution method the team had implemented to allow users access to the packs had also failed, resulting in a lack of accessibility. As part of the distribution method, the packs were left with key stakeholders who were responsible for coordinating distribution within their police force. Unfortunately, the team found that within Windhoek City Police, no one had been given access to these packs, apart from the original stakeholder. Better distribution had occurred within the Namibian Police, but there were still only 6 packs in circulation.

In addition, officers who had access to the packs presented some concern that they would damage it, resulting in disciplinary action, and therefore were inclined not to use them.

The size of the pack also presented key challenges, despite previously gaining positive feedback about its size and shape. In the field its 'bulky design' was felt to cause difficulty in transporting the pack in a vehicle and when attending the scene. Requests were made for a bag and concern was raised about the fragility of the cardboard box. Users noted they would be happy to have fewer compartments in exchange for a smaller box. Users felt that the instructions were sufficient to support the user in sequence of care and that they did not use the compartments. This directly countered findings from the research which identified that users struggled to find items within the bag due to a lack of organisation.

The problems in acquiring in-context data from the police forces prompted a change in methodology, with the team working to identify appropriate alternate first responders to support data collection on the usability of the packs. This resulted in the identification of the City Emergency Services (Fire Brigade and Ambulance) as suitable end users. 29 paramedics from the Ministry of Health and 58 paramedics and 11 Fire Officers from Windhoek Emergency Services were provided with training and access to 48 Trauma Packs (Pack five). In an effort to gain data on the benefits of the bag verses the box, the bags from user testing in May 2017 (pack four) were re-introduced, with three bags given to the Ministry of Health and one to two of the police officers from the Namibian Police who had demonstrated high levels of engagement and had been successful in using the original pack.

5.9 Final Analysis: October 2018 – 14 days

Watkins returned to Namibia to evaluate the success of all of the deployed packs, those with NamPol, Windhoek City Police and the City Emergency Services, all of which had been recovered from their respective field trials. Of all 65 packs (60 x pack five and 5 x pack 4) only half of the packs had been deployed in the field, and of those only 6 had been used. Despite limited use, data collected demonstrated that when employed, the packs had been successful in treating a range of different incidents – 50% by ambulance services and 50% by police. Incidents where the packs were deployed included shootings, stabbings, domestic violence, attempted suicide and road traffic incidents, thus demonstrating first response versatility. The paramedics didn't use the pack at all, despite their opinion that they would use all the packs they were supplied with within two weeks.

To understand why the pack hadn't been deployed in this context the paramedics were invited to engage in a focus group. During the focus group, paramedics complained about the design of the box, in particular the size and the amount of room it took up in the ambulance – describing it as 'finishing off the space in the ambulance.' It is interesting to reflect that prior to the trial, when the paramedics were asked if they would be interested in using the pack, they stated that the box fitted perfectly in the spare space at the back of the truck and that the compact shape was advantageous.

Additional critical feedback from the paramedics included the fact that the box's white colouring showed dirt too easily and that it was too easily deformed, making it inconvenient to use during a trauma incident. In common with other users the paramedic group requested the box be replaced by a small bag.

Misunderstandings surrounded the training provided, which created concerns about when the pack was to be used. Examples of misconception around when the pack should be deployed included the belief that:

- The pack must only be used when there are 3 people injured (i.e. if only one person is injured, don't use the pack);
- The pack should be used until all the items are completely finished;
- The pack should only be used on car accident traumas (i.e. if it's a trauma caused by fighting or stabbing, don't use the pack)

A key finding from the focus groups conducted with the Namibian and Windhoek Police force and Ambulance services was that while they had struggled to use the pack in their place of work, they were keen to purchase a pack for personal use. Both paramedics and police officers recognised that the pack would provide greater benefit for personal use, particularly on long drives outside of the city. They highlighted that the ambulance services are so efficient within the city that Windhoek is not the ideal context of use – another contradiction of original findings. They also highlighted that there are so many protocols within their job roles that using the pack had been a challenge.

6. Reflections

In an effort to overcome some of the challenges associated with parachute design, and comply with the WHO's 4 A's Availability, Accessibility, Appropriateness, Affordability and Crul and Diehl's (2006) 4 P's (People, Planet, Profit and Product), this study adopted a HCD process that draws upon Design Thinking. In doing so the team identified some benefits and a number of challenges. In an effort to support future researchers / designers' intent on designing as foreign designers, below are our reflections.

6.1. Lessons learnt

1. *The Objectives*

   Objective 1 of the MRC funding was 'the assessment of *The Zambian Pack* and *The European Pack's* usability and appropriateness when applied to the Namibian context, followed by an iterative design development process to make the necessary adjustments to make sure the new pack was contextually appropriate.' As a result, the project didn't follow a classic HCD/Design Thinking process of observation in the field during the 'Inspiration' stage. The Inspiration stage (5-day contextual study trip) was limited and relied on past experiences of the UK team, both from Zambian Namibian work, as well as experience and knowledge of local collaborators. Whilst user-centric in approach, the project started with a predefined direction of travel and the outcome was always going to be a trauma pack. The study aimed to assess the viability of applying an existing concept,

developed through HCD for the Zambian context across cultural boarders, into Namibia.

The study recognises limitations of such an approach. Whilst the project applied a user-centric approach and effort was made to ensure adherence to the context of use and end user, the failure to identify the correct implementation strategy early on in the project resulted in unnecessary challenges. Lessons learnt from Zambia suggested benefits of a systems based approach, therefore, utilising police networks within Namibia as a method of distribution and treatment seemed logical. However, as the project progressed it became apparent that the product sat better in the private market for individual sales.

2. *The Contextual Study : Seeing is believing*

In accordance with the literature, the study adopted a human centred approach and effort was made to identify and involve all key stakeholders. The end users were placed at the centre of the study and this in turn informed the design of the studies. Insights were provided by a member of the team with experience of working in country and information was gathered during the initial contextual study. However, the nature of the study and time limitations resulted in an inability to fully immerse and 'hear'. A key element missing was attendance at the scene of a road traffic collision. The team did attend a police night patrol in an effort to gain this experience but no collisions occurred. As a result, the team relied heavily on second hand information and despite data having been collected from a range of sources, this was not always accurate. Information provided by multiple sources highlighted the Police as the first Responders and therefore most likely to provide first responder care at the scene of an incident. Unfortunately for this study, it was not until the implementation stage that the team received counter information and it became clear that this was not usually the case. In response, this study recognises the limitations of accepting information provided on face value. Not enough time was spent in context undertaking observations, for example, attending collisions and reporting on who were in fact the first responders. In theory, the team followed a good process, listening and learning from the people living in context, but what the team had not done was truly embed in the culture for an extended period of time and attend the scene of an RTC to observe the events first hand.

3. *The Data: Believing face value*

Reports from the Namibian MVA show Windhoek as most affected by RTCs, and feedback from the contextual study corroborated this. The study was built on an understanding that Windhoek's high death toll was a result of a lack of infrastructure and a delay in response time. During the contextual study and subsequent training, police officers recounted incidents when they had been first on the scene without sufficient training or equipment, resulting in an inability to provide adequate care. Some of the stories told were truly traumatic and the team were presented with a clear desire for equipment and training. Despite this, once

deployed within context, uptake was limited. Feedback post implementation contradicted some of the original findings and highlighted that there was in fact a structure in place, and that it wasn't as simple as the police being first on the scene and being able to provide care. However, some packs were used and provided lifesaving trauma care.

4. *Time and Money: The ticking clock*

   This study was funded for the duration of 15 months. The project was ambitious in approach with three major objectives: design, educate, implement. The team worked hard to progress within the given timeframe. The project focused heavily on the usability of the pack and the ability for users to provide adequate delivery of care. Unfortunately, the project failed to fully account for the context of use: storage, transportation and location of final use. Factors that ultimately resulted in a lack of adoption. Findings highlight a need for more time to be spent reviewing the product journey and undertaking appropriate mapping (Kaley, 2021). In doing so, it is likely the team would have identified these challenges and they could have been overcome.

5. *Design for manufacture: time, money, shipping*

   It is important to stress the challenges the iterative process of design development placed on the UK manufacture. This project involved an extensive process of design development and iteration. In meeting deadlines, the project costs were increased and some corners were cut. This is particularly evident in the composition of the final pack (pack five). Ideation suggested boxes be constructed from corrugated plastic, however time and budgetary constraints resulted in the use of a white cardboard, a material that was susceptible to damage. Time + budget + user mapping would have resulted in a very different solution.

   Using a UK manufacture enabled the parachute approach. The design team had easy access to the manufacturer who co-designed the solutions ensuring manufacturability. This reduced the number of trips to Namibia and the length of time needed in context – important for financial and logistical reasons. However, the disadvantages of this approach include the need to ship the prototypes from the UK to Namibia which not only increased cost, but significantly impacted on time scale, as shipments took a month to arrive in country. It also meant that future work will be required to develop the design for Namibian manufacture.

6. *Collaboration: planning for the unplanned*

   To overcome many of the recognised limitations of a parachute approach the project was undertaken in collaboration with the University of Namibia. This collaboration was a core strength and made the project feasible. It provided credibility, enabled access to the key stakeholders, the police officers, facilitated training and supported recruitment of research assistants capable of supporting the implementation stage. However, there were still some challenges. A key element of the project's design relied upon the UK team's ability to set up the study, leave Namibia and then manage the study remotely, whilst the two research

assistants (RAs) oversaw the project's implementation stage. During recruitment it became apparent that due to a lack of in-country experience, and the limited tenure (15 months), we would be unable to recruit candidates to the role with familiarity of design, RTCs or first responder care. Despite this, the team were successful in recruiting two assistants with research understanding and experience in the biosciences. Whilst the UK team were in Namibia effort was made to inform, train and engage the two RAs in the project design. Unfortunately, the hand-over presented challenges and it became evident that the time spent with the UK team was insufficient to equip the RAs with the necessary skills to lead the project. This resulted in many challenges and despite efforts at remote communication, included unplanned return trips and delays and limited data collection.

7 Conclusions

This study made a number of key findings which demonstrated both the benefits of applying a Human Centred Design process that calls upon Design Thinking and the challenges of adopting a parachute approach. Adopting a HCD process that draws upon Design thinking, provided a number of benefits and ultimately the team were able to design a first responder pack capable of providing lifesaving care. User testing and evaluation validated the individual components within the pack and implementation supports this claim.

It is important to recognise that collaborating with the University of Namibia, having prior knowledge of the context and access and support from key stakeholders, made the project viable. The fundamentals of organising a project of this scale should not be underestimated and the benefits of working with a partner in country should be encouraged. In addition to this, the team benefitted from lessons learnt from previous projects in Zambia and Europe, which significantly reduced the amount of design work required. However, there were challenges that resulted from time restrictions and budget. In order to meet the project milestones, elements of the HCD process were given insufficient time and others overlooked. If, as presented in the literature, the team had spent more time immersing in the context, it would have resulted in a better understanding of the context of use, enabling the design to be more successful during the implementation stage. The issue of time also impacted on design decisions.

Having read the challenges and criticisms of parachute design, the project design aimed to overcome limitations through close collaboration with the university and the appointment of two RAs in country. Despite this, the logistics were still challenging. The team struggled as a result of limited understanding of the implementation stage and an inability to adapt the study in response to the challenges faced, resulting in unplanned returns. Reliance on correspondence via email and messenger was time consuming and made communication challenging. Internet connections could not be guaranteed and being 7,500 miles away meant that the UK team could not easily return, witness and understand the situation on the ground.

7.1 Recommendations for future studies:

1. *Flexibility and Resilience* –There isn't a perfect guide book on '*how to design for ** context'*, but there is guidance on how to ensure your process is user-centric in approach. It is recommended that researchers recognise the challenges of designing for a foreign environment, ensure they have an understanding of various user-centric approaches, and develop a methodology that can be flexible in approach. Things won't always go as planned and therefore resilience is going to be key. Allow time to contextualise yourself before jumping straight into the deep end.

2. *What works for one might not work for another* – when taking a concept across cultural boarders, try not to draw too much on preconceptions or prior experiences. Try to filter your thoughts and ensure adherence to the necessary process of divergent inspiration. This is very hard and sometimes you don't know you've pulled on preconceptions until it's too late. But don't be afraid to recognise your mistakes and make the necessary changes to your project design.

3. *Stakeholder and Your Team* – be prepared to go beyond the noise, divergent exploration is key. When tackling a design project, we're often encouraged to identify our stakeholders early in the design process. But it's important to acknowledge that that's a lot easier to do in a familiar environment. When you're starting from scratch in a foreign environment, we'd recommend taking time to ensure that you have a true understanding of the bigger picture and that you use your research findings to establish an appropriate in-country team. Try to avoid establishing your team too early as this could push your project into the wrong space too soon. For example, have you observed the problem you're trying to tackle first hand and who was at the scene / involved?

4. *Believing face value* – understanding that what people say they do isn't always what they do, and that we all have our own perspectives and agendas. There is a lack of guidance on how to ensure the accuracy of insights and our study found that the key is time, getting to know people, and experiencing different places. Divergent exploration during the research stage is critical in ensuring the credibility of your insights. No matter how many times you are told something, and no matter how credible the source, we strongly recommend that you seek the opportunity to witness it first-hand.

6. *Time and Money: the ticking clock* – when applying for funding, be realistic and set achievable goals. When designing for a foreign environment it is easy to underestimate the challenges you might face. Different cultures can work differently and at a different pace, resulting in things moving quicker or slower than intended. It is essential to account for this. Deadlines and worry can have a big impact on the resilience of a team, running out of money or overspending can be incredibly stressful and can result in reduced outputs.

7. *Variables* – this point seems so obvious, but the nature of user centric practices means that we're always listening to feedback and using this to drive the design project. Feedback can increase the complexity of things. Simplification of the

approach taken and the design outcomes is critical. When too many factors are involved this can result in too many variables for objective evaluation.

8. *Planning for the unplanned* – expect the unexpected, if you are applying a parachute approach be ready to return if necessary and set a contingency budget aside.

9. *Collaboration* – do not undervalue the benefits of working with the stakeholders, this can make or break the project. Once collaborators are established ensure that you're working in partnership. Whilst the project presented in this paper encountered challenges, it also recognises the benefits of the partnerships which made this project possible.

8 Study Limitations

A number of limitations must be acknowledged, including the remote, parachute approach employed, previously criticized by Donaldson (2008). For this study, to support the parachute approach, the team worked to identify suitable collaborators to take the study forward in the Namibian context, removing the need for remote management. As part of this approach, two Research Assistants were employed at the University of Namibia. Unfortunately, their employment did not provide as much benefit as hoped and it must be recognised that such a study was unusual in the Namibian context so that sourcing appropriate skills was difficult.

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Figure 7: Location of Windhoek in Namibia [online] https://www.google.co.uk/maps/place/Windhoek,+Namibia/@-22.3096253,15.404699,6.13z/data=!4m5!3m4!1s0x1c0b1b5cb30c01ed:0xe4b84940cc445d3b!8m2!3d-22.5608807!4d17.0657549 (Accessed 2nd June 2021)