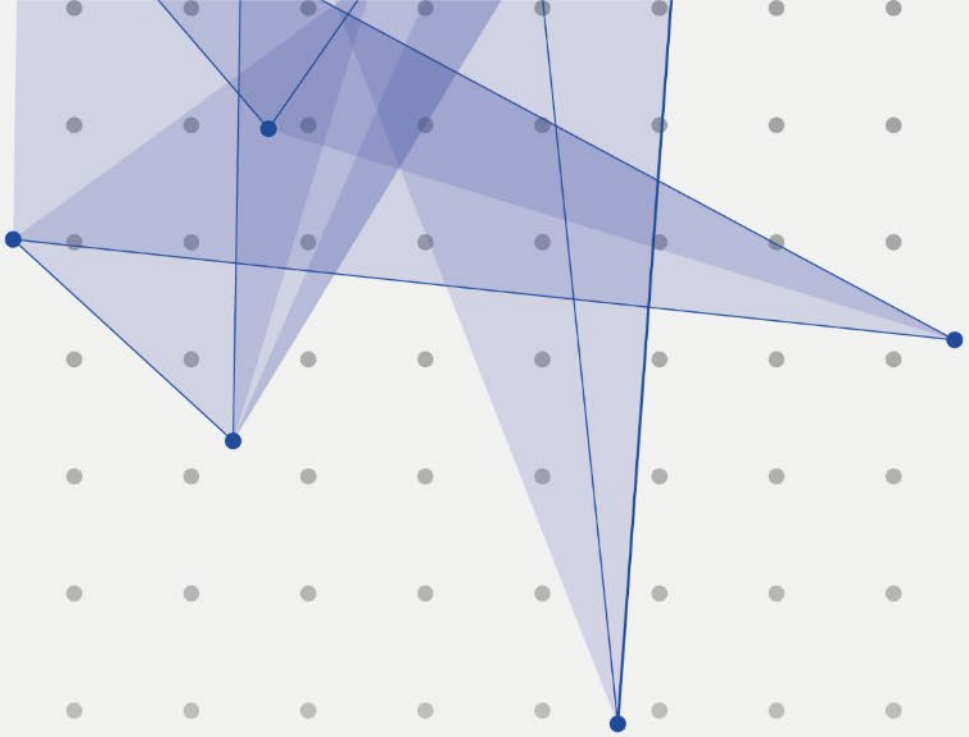

Eksig 2023

"**From Abstractness to Concreteness** – experiential knowledge and the role of prototypes in design research"

Proceedings

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Design Research Society DRS

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DIPARTIMENTO DI DESIGN

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Process as prototype: exploring complex knowledge exchange in the production of low-cost buoyancy aids in Zanzibar through the participatory design of a ‘workflow system’

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Abstract

This paper reports on an investigation into the role of experiential knowledge in growing capacity for producing low-cost buoyancy aids with soft goods manufacturers – tailors – in Zanzibar, set within complex knowledge exchange collaborations under academic-industry partnerships. In this study, the makers' practice of tailoring and their local environment knowledge had a formative role in designing a prototype ‘workflow system’ for local, small-batch production of low-cost rescue throwlines as part of a wider community-led water safety programme.
The study builds on a previous phase of the research that identified limitations with a human-centred design (HCD) approach to the creation of opensource instruction manuals for low volume production of rescue throwlines. We propose that the previously incumbent HCD approach through its problem-solving procedures obscured the importance of the local makers’ participation in the *problematisation* of the manufacturing process. By foregrounding the local makers’ knowledge of the whole manufacturing process, from sourcing materials in the market to making and testing the products, this study aimed to investigate how the local makers would devise and develop their own methodological approach to making the rescue throwline, examine what the findings would suggest for the design of the throwline, and explore how this knowledge might be exchanged with other collaborators in the project. A further and longer-term aim is to support the development and impact of local capacity building in end-to-end drowning prevention management by demonstrating the importance of experiential knowledge in existing local communities of makers.
A participatory making approach informed by design thinking underpinned the design of the study. An experimental participant-led approach to the generation of data draws attention to the different positions and types of knowledge negotiated. The study elucidates some of the barriers for exchanging this critical experiential knowledge with collaborators and exposes challenges for creating new social infrastructure within the community concerning drowning prevention. It concludes that managing complex knowledge exchange in prototyping in the Zanzibar context requires an iterative methodological approach to the co-construction of knowledge centred around the experiential knowledge and skills of the users of the ‘workflow system’.

Experiential knowledge; participatory design and making; workflow system; drowning prevention; complex knowledge exchange.

The United Republic of Tanzania (URT), which includes Zanzibar, is one of the countries whose population is most vulnerable to death by drowning (WHO, 2014; Sarrassat et al, 2019). As a result of wider advocacy work by the Royal National Lifeboat Institution (RNLI) and others, in April 2021 the United Nations (UN) passed a Resolution setting out urgent action for drowning prevention across all countries and UN agencies[1] – the first in its 75-year history. One of the key factors leading to this intervention has been the inability of local communities and small organisations in low-resourced countries, like Tanzania, to sustain the production and upkeep costs of specialist manufactured ISO standard drowning prevention devices, such as the rescue throwline in Figure 1. In response, the RNLI has been working with global partner organisations to research and develop community-led water safety capacity[2], which includes developing capability for producing life-saving buoyancy aids such as low-cost rescue throwlines.

Figure 1: ISO standard rescue throwline designed and manufactured by Eval in Greece (2020). Object number: AIBDC: 009367. Photo: MoDip, Arts University Bournemouth.

Since 2019, the Arts University Bournemouth has been consulting with the RNLI to deliver manufacturing guidance and tools that can be managed in-country by communities and local NGOs. One of the core activities has been to grow capacity for producing low-cost rescue throwlines that adhere to RNLI safety-critical standards, thereby omitting the need for costly intermediary supply chain actors and increasing the likelihood of community involvement. In doing so, this project works towards a theory of change such that as new markets in drowning prevention capacity open up, so too do possibilities for entrepreneurship and sustainable socioeconomic growth. Out of this, the Arts University Bournemouth established

[1] https://rnli.org/news-and-media/2021/april/29/un-adopts-historic-first-resolution-on-global-drowning-prevention (Accessed 16th January 2023)
[2] https://rnli.org/what-we-do/international (Accessed 16th January 2023)

a partnership with Pamoja Zanzibar (Pamoja), specifically Pamoja's tailoring school[3] based in Kisauni, Zanzibar, and conducted several creative design workshops in-country (Conrad & Devall, 2020).

This paper focuses on a period of activity conducted in 2021 between the Arts University Bournemouth and Pamoja. It discusses aspects of this process of growing capacity focussing on the complexity of knowledge exchange across disciplines, institutions and cultures. It concerns the role of participatory design and maker knowledge in grassroots innovation, and in particular the intangible knots of experiential knowledge that we discovered to be crucial in refining the prototype of an appropriate, context-specific workflow system for producing low-cost rescue throwlines. The activities presented here took place in Zanzibar at Pamoja, and the research team worked remotely from the UK due to prohibitive international travel restrictions as a result of the Covid-19 pandemic.

The background to the problem

The complexity involved in undertaking collaborative and interdisciplinary projects, particularly where creative design and making practices are concerned, presents opportunities for design research (Bowen et al, 2016). In this instance, the RNLI and its water safety partners initially applied a human-centred design (HCD) approach to the development and testing of a new-to-the-market product, the rescue throwline, drawing together expertise in water safety, product design and user-centred design. The HCD approach primarily involves users and stakeholders in the *problem-solving* design process, rather than *problematisation* (Vines et al, 2013), which is an important distinction to point out, especially in this instance where the success of the drowning prevention programme depends on community uptake and ownership. Problematisation here is approached as a collaborative process of problem formulation, where the "nature of problems" is explored and refined through creative practice (*ibid* 2013, p.192). In such settings, the frame within which a design thinking approach is applied can create the constraints to enable (or disable) instrumental value in the process (Dorst, 2011). This value is intrinsically tied to the experiential knowledge of all stakeholders. Furthermore, it can lead to enhanced uptake when the knowledge about the product's purpose and its features is expected to transfer across complex disciplinary, socio-economic, cultural and linguistic boundaries without resistance, misunderstanding and/or rejection.

Whilst we acknowledge that the research team has expertise in design, making and innovation developed in a largely Euro-western context, and "brings to bear … a cultural orientation, a set of values, a different conceptualization of such things as time, space and subjectivity, different and competing theories of knowledge, highly specialized forms of language and structures of power" (Tuhiwai Smith 2021, p.49), we understand the importance of expanding design research methods towards a more inclusive approach, particularly in the framing of the problematisation process. In Zanzibar, where manufacturing capacity is very small scale and makers are likely to be closely involved in the whole

[3] Pamoja Zanzibar is an NGO, based in Kisauni outside Zanzibar City, that offers vocational training programmes and qualifications in car mechanics and tailoring as well as water treatment facilities: https://www.pamojazanzibar.org/index.php/en/ (accessed 27th January 2023).

process of product development and use, we determined that the HCD design thinking approach employed previously, obscured the importance of *participation* as a way of designing for and *with* people. The local community of makers, although they had not been directly involved in the problem-solving process of designing the rescue throwline, were important components within the complex knowledge exchange process. Reframing the problematisation process, with their participation, around the context of manufacturing capacity identified a new set of problems and brought a new perspective to the bigger picture of capacity building. By bringing in a creative participatory design approach to capacity building that includes the experiential knowledge of local communities of makers in developing prototypes of supply, manufacturing and testing processes, we propose that a broader group of stakeholders can be engaged in the ownership of the drowning prevention management process.

The research presented here builds on the challenges of the product prototyping observed in previous iterations by Conrad and Devall (2020), which explored the ability of Pamoja's tailoring community to adopt opensource instruction manuals produced as a result of the RNLI's earlier HCD research on the design, development and testing of the new-to-the-market throwline. Conrad and Devall (*ibid*) found that the opensource instruction manuals had been designed for makers familiar with industrial scale manufacturing systems and were not adapted appropriately to the Zanzibar context. Furthermore, these manuals failed to reflect the role of experiential knowledge in successfully making a throwline to the RNLI safety critical standards.

Project aims and objectives

Given the importance of involving local makers in problematising the manufacturing process in order to negotiate the complex collaboration necessary for low-cost throwline development and local community management of drowning prevention strategies in low-resource settings, our intentions were to:

- investigate how the makers (Pamoja tailors) would devise and develop their own methodological approach to making the rescue throwline.
- examine what the findings would suggest for the design of the throwline.
- explore how this knowledge might be exchanged with other collaborators in the project such as the RNLI.

Characteristics of 'designerly thinking' have been applied using the role of making as inquiry (Johansson-Skoldberg, Woodilla & Cetinkaya, 2013; Cross, 2007). In this research, the role of making as inquiry extends to include participatory making, which allows for a more inclusive approach to community participation, and importantly provokes questions concerning skills, ways of working and positions of knowledge. For instance, local environmental knowledge has been exchanged through engagement in activities with participants (Berg, 2008) that centres their expert knowledge developed in the Zanzibar context.

As mentioned above, the buoyancy aid in focus for this study is a low-cost 18m long rescue throwline designed and developed in 2019 by the RNLI International team. An instruction manual for making the rescue throwline, initially developed by the RNLI and revised by the Arts University Bournemouth research team (Conrad & Devall, 2020), is available as an opensource download via the RNLI website[4] (Figure 2). The design and its safety-critical features as presented in this document are referred to as the template for how the product should look and function.

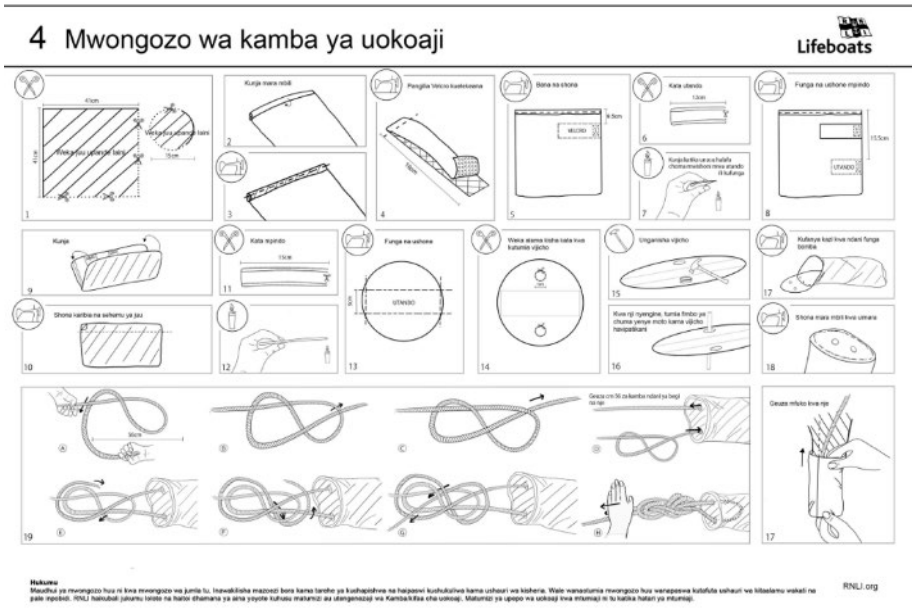

Figure 2: An example page from the low-cost 'Rescue Throwline Manual' in Swahili, an opensource download tool available from the RNLI website.

The rescue throwline is made from a bright orange nylon fabric bag with black webbing handles, stainless steel eyelets and a twisted polyethylene rope (see Figure 3). All materials need to be available to buy locally. Local makers with capabilities in small-scale soft goods making[5] and a situated knowledge of supply chain capacity within the Zanzibar region were identified as participants for this study: the Pamoja tailors.

[4] https://rnli.org/what-we-do/international/international-resources - 'Rescue Throwline Manual' (Accessed 16th January 2023)
[5] Known as 'tailors' in Zanzibar, and hence referred to as tailors here.

Figure 3: The rescue throwline product prototype, designed by the RNLI International team and produced by Pamoja tailors, Zanzibar (2019). Object number: AIBDC: 008485. MoDip, Arts University Bournemouth.

Methods

Returning to the project aims and taking into account the importance of involving local makers in problematising the manufacturing process in order to better understand how to move towards a participant designed 'workflow system', we set out to learn from the tailors how they set about making the throwlines from sourcing the necessary materials, through to making and testing the products. For this, the study used a combination of methods. Over a period of two months in 2021, meetings and discussions were held with the Pamoja tailors on Skype interspersed with workshop activities undertaken by the tailors on location at Pamoja's tailoring school. We devised specific tasks for the workshop activities to interrogate the tailors' process and question prompts to guide documentation. In asking the tailors to describe their processes more explicitly than they might otherwise, the objective was to elicit context relevant detail about their approach to making the rescue throwlines. This in turn informed the participatory approach to designing the 'workflow system'. These activities were organised around six stages:

1. Mapping the tailors' capabilities and Pamoja's capacity for manufacturing the rescue throwlines.
2. Gathering materials needed, e.g. sourcing fabric, rope and notions from the market.
3. Preparing materials for production, e.g. cutting out requisite amounts of fabric and rope.
4. Making and testing the rescue throwlines, including further problematisation of

making techniques.
(Two iterations of stages 3 and 4 enabled refinement and consolidation of the production process.)

5. Trialling ways of communicating the process for exchanging the experiential knowledge of resourcing, manufacturing and testing the rescue throwlines.
6. Devising the guidelines for the ‘workflow system’.

A research assistant/translator was employed on location to facilitate discussion between the English-speaking research team and the Swahili-speaking tailors. The Skype meetings held at the Pamoja tailoring school were recorded and documentation of the tasks/workshop activities including photographs, short video clips and voice memos were sent back to the research team via WhatsApp by the translator. The advantages of using WhatsApp were a) it is an affordable instant messaging service that required no additional costs or equipment from participants and b) it facilitates the collection of ‘real-time’ data over both time and place (Manji et al, 2021). Methodologically speaking, this approach to participant-led data generation was new for the research team and we welcomed this as a way to build trust and adjust the balance of power between researchers and participants (Kara, 2018). Visual and text-based analysis of the data was shared with participants using an online whiteboard tool (Miro) throughout the length of the study.

The project: understanding the makers’ process and creating the prototype workflow system

Returning to the project aims and taking into account the importance of involving local makers in problematising the manufacturing process in order to better understand how to move towards a participant designed workflow system, we first set out to observe how the tailors make the throwlines from sourcing the necessary materials, through to making and testing the products. We devised specific tasks to interrogate their process and question prompts to guide documentation.

Some of the tailors at Pamoja had already been involved in earlier stages of the research in 2019, including the head tailor, Josephina, and her deputy, Mwanahamis. In order to avoid overlooking any essential information that might have become absorbed intuitively into the embodied knowledge of making held by Josephina and Mwanahamis, we stipulated that they work with at least one tailor with no prior experience of making the throwline to be able to report back to us on their learning. We worked with five tailors for this study: the head tailor, her deputy, two trainee teachers, Almish and Zainab, who had been involved in making throwlines previously, and one tailor with no prior experience of making the throwline, Mwajuma.

An initial mapping exercise established the tailors’ making capabilities, their role in the Pamoja organisation, their skills, access to equipment and other claims on their time. This enabled us to understand the scope of possibilities and the limitations. All participating tailors held a tailoring qualification and worked independently, either on individual commissions or producing soft goods for the tourist economy, as well as at the tailoring school. All had access to sewing machines. All held other jobs in addition to their tailoring such as farming and animal husbandry, cooking and domestic duties.

This was followed by a trip to the market in Stone Town, led by Josephina and Mwanahamis, to source and buy the materials needed to make two batches of ten throwlines, overseen by Josephina. The first batch was made to problematise the process, identify and document any challenges; the second batch was made to confirm the workflow system as a proof of concept.

The next stages of the project involved exploring ways to formulate and communicate the knowledge gained. This was achieved through two ‘chemsha bongo’ (brainstorming) sessions, led by the research assistant on site, that explored the best ways to show and explain how to make the throwlines respecting the critical safety standards required (see Figure 4). This involved a combination of description, drawings, making samples of certain components and additional revisions to the original manuals.

Figure 4: ‘Chemsha bongo’ brainstorming session at Pamoja: exploring ways to formulate and communicate the tailors’ knowledge.

A final stage resulted in the drafting of guidelines embracing the whole workflow system that can serve to pass on the knowledge of how to make the throwlines to other tailors. These guidelines, in Swahili, with added illustrations and short video clips, make reference to explicit procedural knowledge (Niederrer, 2007), such as the correct measurements required and how to secure the holes for the rope to pass through, as well as an implied experiential knowledge (*ibid*) specific to the tailors’ context in Zanzibar, such as ‘window shopping’ for sourcing materials and pulling on the rope to test the security of the knot.

The role of experiential knowledge in developing the ‘workflow system’ prototype

Conrad and Devall (2020) had already shown that the opensource instruction manuals only partially succeeded in exchanging knowledge of the critical safety standards embodied in the RNLI designed throwline. The knowledge exchange ‘system’ of instruction manuals did not completely fulfil its role. Smith et al (2017), argue for “increasing creative input from workers” (p.39) in relation to the introduction of new technologies into production processes, stating

that “systems designed without thought for user skills resulted in serious failures, as well as resistance” (Smith et al. 2017, p.39). The Pamoja tailors, users of the system in question, found that the manuals did not reflect essential information specific to how they apply their skills in their particular context. As a result, the manuals were not used by the tailors as intended. They preferred to refer to the product prototype instead, bypassing sections of the instruction manuals, and drawing directly on their own experiential knowledge of making processes accumulated with the basic tools they are used to using (e.g. second-hand domestic sewing machines, scissors, dress-making tape measures, chalks for tracing the fabric pieces) and the spaces they are familiar with.

Soft-goods manufacturing – tailoring – in the Zanzibar context is small-scale and largely part of the informal economy (Bonnet et al, 2018)[6]. As an indication of the manufacturing capacity, Pamoja, an established organisation, could manage the production of batches up to a maximum of 100 throwlines, but would cut out and make them one at a time. Individual tailors are more likely to work from their homes with considerably less capacity. Tailoring in Zanzibar is a grassroots livelihood without supply chain infrastructure and streamlined manufacturing. The tailor making the buoyancy aid is also sourcing and transporting the materials, preparing space for the production process, sewing and testing the product; they are involved in the whole manufacturing process.

We realised the knowledge necessary to be able to reproduce these rescue throwlines and pass the knowledge on to others cannot be wholly and reliably contained in an opensource instruction manual; it is distributed across the whole process. Instructions for making the products needed to extend to guidelines for the whole process. The prototype we were therefore developing with the tailors was a context specific ‘workflow system’ - a design process that supersedes the design of the physical product. The tailors’ experiential knowledge – the knowledge accrued from their experience of sourcing supplies in the market, calculating quantities and preparing for production with little space, basic tools and using second-hand sewing machines – was essential for its development. A participatory design approach (Vines et al, 2013; Halskov & Hansen, 2015) was necessary to facilitate the exchange of this knowledge across the disciplinary, socioeconomic, cultural and institutional boundaries. As with a product prototype, there were iterations of this process in order to better understand how it worked for the tailors and identify points of difficulty or misunderstanding that required clarity in order to ‘write down’ the workflow system.

What follows is a discussion of three key instances that demonstrate the crucial role played by experiential knowledge in the design of this prototype workflow system:

- Procuring materials
- Using appropriate technologies
- Testing safety critical standards

Procuring materials

Developing the workflow system took into account the whole making process and highlighted the place occupied in this process by the procurement of materials. As mentioned above, the tailor

[6] Women are more likely than men to be occupied in sectors of the informal and semi-formal economy in Tanzania (such as tailoring) by 2.5 to 5 percentage points.

making the throwline is also sourcing and transporting the necessary materials. All materials for making the throwline are sourced at the central market in Stone Town from chandlery stalls, haberdashery stalls and other related suppliers such as shoe manufacturers. Knowledge of where to find the necessary materials is gained by 'window shopping', whereby the tailors, in a small group of three, visit the market together to seek out the best and cheapest suppliers of the materials needed. There are a limited number of suppliers in the market and stock needs to be assured. Familiarisation of the materials used, prices and where to find them is achieved by regular visits to the market. Josephina, the head tailor, recommends tailors go 'window shopping' before buying what is needed:

> Josephina normally does 'window shopping' first to scope out the materials and components for prices and location but the prices fluctuate so you still need to keep in mind what might be the case for different prices on the day.[7]

'Window shopping' is then usually followed up with a second trip to buy the materials identified. However, for this study, she felt it was important the tailors have the whole experience of going to the market and walking around to find *and* buy what they need, emphasizing the need to gain experience of the searching, calculating and negotiating required, as well as knowing what to look for:

> Josephina decided to take the whole team to the market and do the scoping and purchasing together (rather than in two different trips) so the team can get a feel of how much you'd need to decide when selecting supplies.

For the purposes of this study, Josephina wrote a shopping list to calculate how much/many of each component was needed for making ten throwlines. Normally, this information would be memorised. Exact quantities are bought for the number of throwlines to be made. Where quantities are packaged up approximately, prior knowledge of what is sufficient for the task is essential. For example, the polyethylene rope is sold in bundles of approximate lengths of 17-19m and it makes sense to use a whole bundle per throwline rather than waste small lengths to achieve precision to the nearest millimetre.

[7] Quotes are taken from voice memos translated from Swahili to English by the translator.

Figure 5: Sourcing supplies: tailors shopping in Stone Town central market for materials to make the throwlines.

The experience of sourcing materials also includes journeying to and from the market. Tailors may take the ‘dala-dala’ (public transport) or be driven to the market in the car owned by Pamoja. In this instance it was more efficient to use the Pamoja car to transport bulky bundles of rope and fabric. In either case, the amount of fabric and rope bought is limited by what can be carried on foot.

Figure 6: Transporting supplies: Mwanahamis and Zainab carry the bundles of rope from the market to their transport.

The knowledge required to successfully procure materials for making the throwlines in the Zanzibar context is not theorized and automated by a system operated by other interlocutors distanced from the makers (Smith et al, 2017; Tuhiwai Smith, 2021). Knowledge of how and where to source materials can only be fully understood by the tailors if they go to the market in person, literally pacing out their knowledge by walking round the market and talking to suppliers in person, familiarizing their whole bodies with the task. This knowledge is experienced physically and is not usually written down but held in memory. The experiential knowledge concerning the procurement of materials is also described by the limitations of the body; knowing how much can be bought in one trip is limited by how much material can be carried on foot. In turn, this influences how many throwlines can be made at any one time and therefore, has implications for building capacity and socioeconomic growth. Understanding this knowledge position, and its limitations (as seen through our Euro-western lens) has been crucial in the development of the workflow system but does present challenges for the exchange of knowledge with other stakeholders.

Using appropriate technologies

Use of the term ‘appropriate technologies’ here is informed by principles aligned to the Appropriate Technology (AT) movement: “a more situated, environmentally concerned and socially just set of design and operational principles for diverse technology choices by involving local communities” (Smith et al, 2017, citing Kaplinsky, 1990), and their experiential knowledge of their environment (Berg, 2008).

Firstly, the use of millimetres in the measurements cited in the original opensource instruction manual should be highlighted. This is standard practice used in prototyping and knowledge exchange by designers and engineers in a high-volume manufacturing context. The assumption that it would be so in the Zanzibar soft goods manufacturing context exposes the different knowledge positions held by the different partners in the project, and indeed the imbalance of power. In practice, the tailors, without access to precision tools, default to their habitual use of centimetres measured using tape measures (see Figure 7) and this was reflected in the amended instructions developed during the ‘chemsha bongo’ sessions as seen in Figure 8.

Figure 7: Preparing for production: measuring out fabric in centimetres using a tape measure.

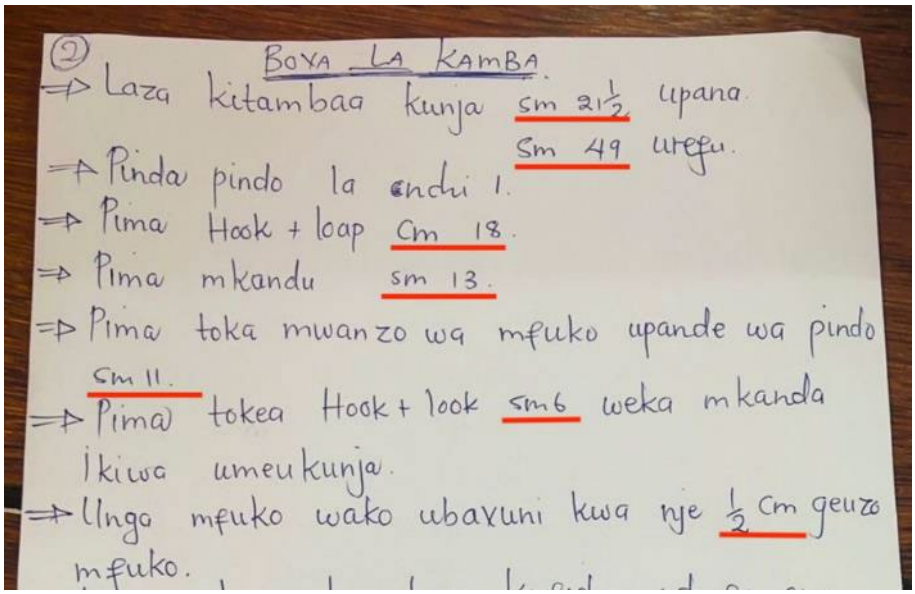

Figure 8: Working in centimetres: instructions for making the throwline indicating measurements in centimetres.

Second, as trust built between the research team and the Pamoja tailors, particularly through the latter stages of the project and the ‘chemsha bongo’ sessions, they initiated alterations to the original design of the throwline. Stainless steel eyelets, as specified in the instruction manuals, as used in Figure 9, were abandoned in favour of a self-faced hole in the fabric (see Figure 10).

Figure 9: Inserting stainless steel eyelets in the base of the throwline to reinforce the holes as stipulated by the original instruction manual and in the original prototype.

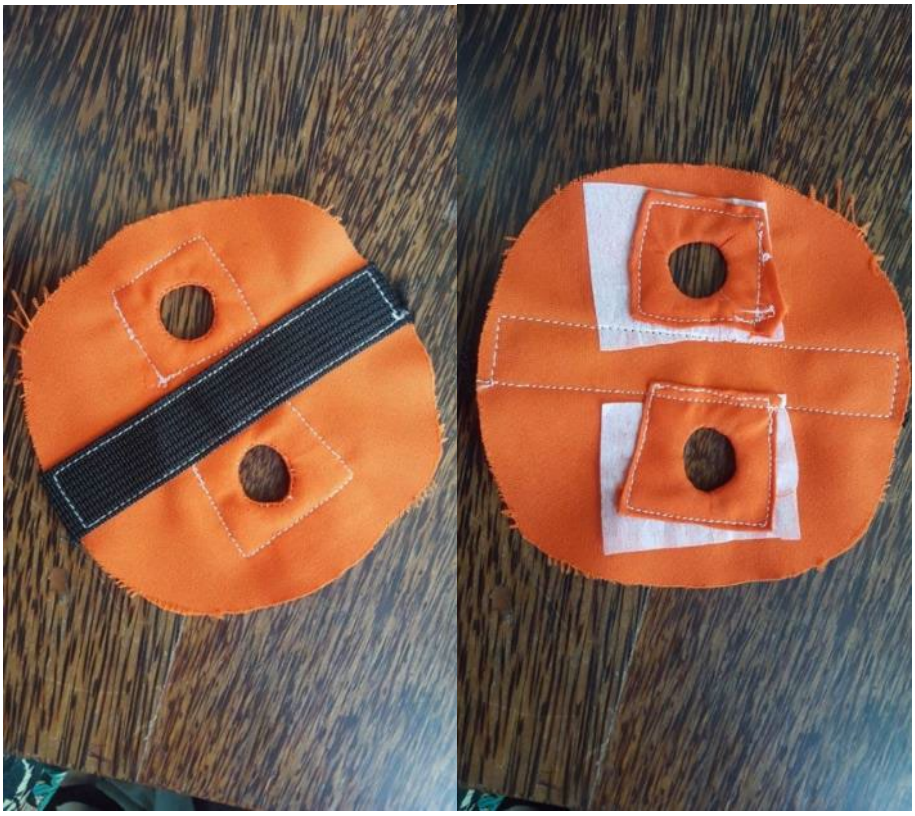

Figure 10: The tailors' modified design: self-faced reinforced holes.

These alterations were prompted by their knowledge of their local environment. The sea water around Zanzibar has a high saline content, which results in the rapid rusting of metal components,

thereby shortening the product's useful life and/or risking product failure. In addition, the Stone Town market stalls have an unreliable supply of correctly sized eyelets. A more reliable and dependable method was devised. The tailors' experiential knowledge facilitates this initiative and we see them becoming active agents of innovation making their own appropriation (Smith et al, 2017 p.11) of the throwline. Problematizing the process (Vine et al, 2013) in the initial stages of this study with the tailors and creating opportunity for them to reflect on their knowledge through the 'chemsha bongo' sessions, resulted in them leading the problem-solving stage of the project.

Testing safety critical standards

It is important to note that the rescue throwline is part of a series of products and activities within the Zanzibar-based RNLI water safety programme. On its own, it cannot replace other devices relied upon to save lives, but it can be used as part of growing capacity for drowning prevention. To this end, it is crucial that the throwline meets the RNLI safety standards.

The throwline is intended to be thrown from a place of safety on dry land to a person in difficulty in coastal waters. The end of the rope is held by the person on the shoreline and the bag containing the length of rope is thrown to the person in difficulty in the water. A handle at the base of the bag allows the person in the water to hold onto the bag and be pulled to safety. The handle is created by knotting a loop securely into the length of rope. It is imperative this knot holds fast; if it is not tied securely and slips undone, the person in difficulty could become detached from the bag and the throwline fails.

Tying a knot is challenging to represent in instruction manuals, whether as an image or in words, or a combination of both. Knowing how to tie a knot relies on tying the knot in real time, sensing the journeys of the rope over and under and through the various loops created by fingers and hands. Knowing if the knot is secure depends on feeling the rope pulled under tension and simultaneously watching for any signs of movement that will indicate slippage. Figure 11 shows the tailors testing the security of the knot.

Figure 11: Two people pull on the rope, holding the handle to test the security of the knot.

Perhaps even more than other stages of the throwline production, tying the knot requires an experienced makers' "constant interplay between tacit knowledge and self-conscious awareness, the tacit knowledge serving as an anchor, the explicit awareness serving as critique and corrective" (Sennett, 2008 p.50). However, the experiential knowledge of tying the knot correctly and securely evades description in two-dimensional illustrations. Instead, the tailors made short video clips of the knot-tying process, which helped by allowing them to view the process objectively and identify critical gaps in the manual illustrations. Although to some extent still unresolved, this resulted in an improved and more detailed visual explanation. Figures 12 and 13 show the gaps in the original instructions completed by new drawings made by the tailors.

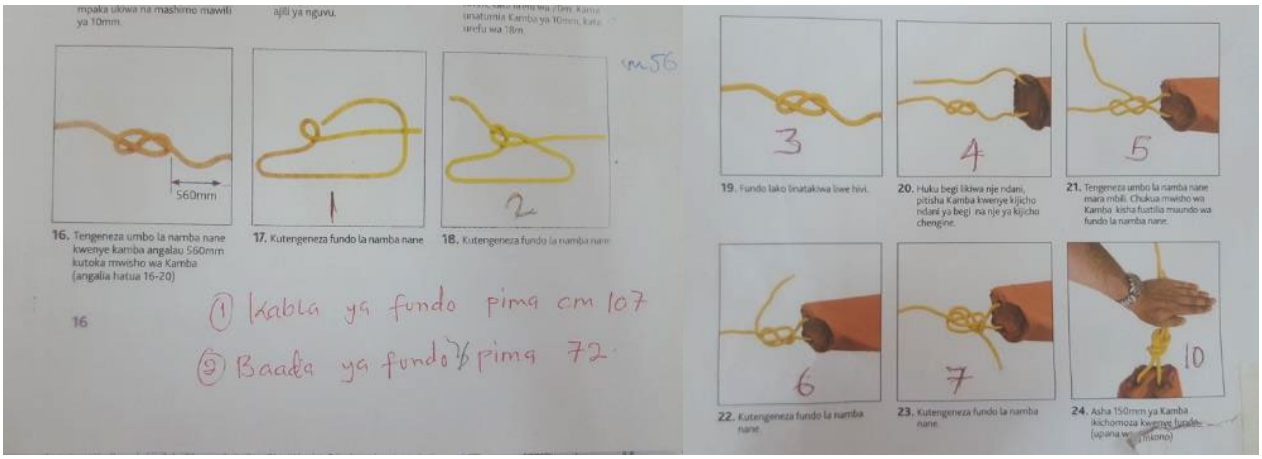

Figure 12: Studying the procedure for tying the knot as specified in the original instruction manual and identifying missing information between stages 7 and 10.

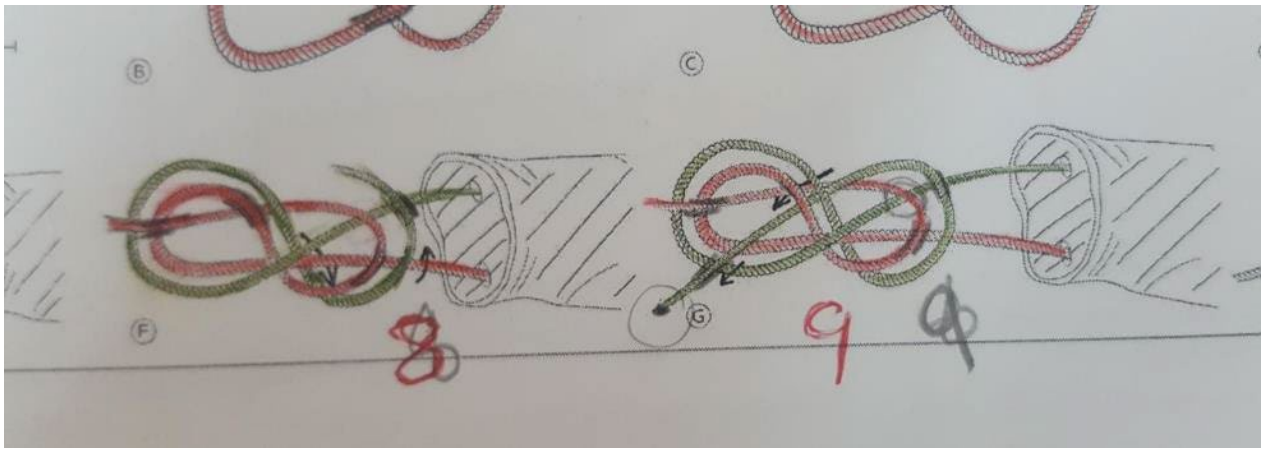

Figure 13: Clarifying the missing stages 8 and 9 using colour to distinguish between the two ends of the rope needed for tying the knot.

Conclusion

This study has shown how the transition from a human-centred design (HCD) approach to a participatory design and making approach that embraces the whole process of manufacturing low-cost rescue throwlines in Zanzibar, from sourcing materials in the market through to making and testing the product - the 'workflow system' - highlights the importance and value of context specific experiential knowledge. The study builds on suggestions by Conrad and Devall (2020) that opensource design tools for the community production of low-cost throwlines fell short of providing opportunities for experiential knowledge and feedback loops to benefit community uptake of the drowning prevention initiative. The making process had been translated into a set of codified instructions that assumed the knowledge could be transferred. Not including local makers' experiential knowledge in the design of the manufacturing process risked not only safety critical processes being resisted or rejected, but limiting the adoption of the products within the community managed water safety programme.

The 'workflow system' prototype draws from the expert knowledge of safety critical design

contributed by the RNLI International HCD team, the tailors' local environmental knowledge, the experiential knowledge of design and making shared by the tailors and the research team, although from different positions of culture, race and privilege. By including the tailors in the creative practice of *problematisation* as well as the *problem-solving* process, a more environmentally and technologically appropriate guidelines and samples were produced to clarify difficult-to-make features which might occur within the process of small-batch production. An overall understanding was reached about how these additional components can be used alongside design tools such as the opensource low-cost production instruction manual as well as physical prototypes to form more holistic and comprehensive 'workflow system' that takes into account these experiential dimensions of intangible knowledge exchange.

This study has also highlighted that in order to enact change towards the community adoption and management of low-cost buoyancy aids, the tailoring community can play a vital role with their creative practice as mediators of design languages across institutional and cultural boundaries, whilst also negotiating technological and material networks. Developing the prototype 'workflow system' with the tailors at Pamoja demonstrates the complexity of knowledge exchange at play. As such, this creative design and making practice has been seen to engage expertise and knowledge from multiple disciplines (Nimkulrat et al, 2020). Not only is the knowledge from different disciplines (design, engineering, water safety, making) but it is of different types (practical, theoretical, environmental, experiential) and differently positioned (Euro-western, Indigenous Tanzania/Zanzibar).

One of the key questions we as researchers have asked ourselves over the course of this study has been to what extent, or how, might the results offer a generalised contextual replication of use to other communities. When considering this as a course of 'next steps' we need to return to one of the core aims of the study, which was to highlight the role of makers in the capacity building process for drowning prevention in Zanzibar. We argue that for this to be effective, an open and iterative 'workflow' system that continually responds to localised adaptation for capturing complex knowledge exchange is more appropriate for developing capacity-building than a new codified 'instruction tool'. It is crucial that contextual and local experiential knowledge can be easily adopted into the manufacturing process for it to be owned by the makers themselves. A codified (and therefore fixed) 'instruction tool' may lead to the replication of resistance or rejection in another setting. It is our intention to study how, or if, this 'workflow system' might be applied in a different setting, in Tanzania, as part of the next steps in this study, and to what degree the 'workflow system' developed needs to be adapted by a different community of makers to support this complex knowledge exchange process.

We recommend adopting an iterative methodological approach to innovation for managing complex knowledge exchange projects such as this; one that favours collaboration across disciplines *and* knowledge positions. The study elucidates some of the barriers for exchanging this critical experiential knowledge with stakeholders, but also exposes challenges for creating new social infrastructure within the community concerning drowning prevention that points towards continuing research:

- Understanding the context of different knowledge positions regarding design and manufacturing.
- Communicating alterations in the design that respond better to the environment.
- Developing confidence in experiential knowledge-based safety testing methods.

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Dr Emma Shercliff

Dr Emma Shercliff is Associate Professor of Textiles and Participatory Making at the Arts University Bournemouth. With over 20 years' experience devising, participating in and leading creative workshops with various participants she has developed a focus on creative participatory research methodologies and participatory approaches to design, making and cultural engagement applicable to wider cross- and interdisciplinary research, knowledge exchange and consultancy settings. She is co-founder of the Stitching Together research network, which brings together researchers, professional textile practitioners, project commissioners and enthusiast textile maker groups to foster critical dialogue around participatory textile making in research and practice. Emma is a peer reviewer for various academic journals and co-editor of the Journal of Arts and Communities. Her current research addresses the development of community owned work-flow systems for the making of life-saving buoyancy aids in Zanzibar using a participatory workshop-based methodology with tailors, and the development of an evaluation framework for creative participatory making activities in research contexts.

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I am an interdisciplinary researcher, interested in the roles design can play within the concept of innovation ecosystems. Alongside my work as the Innovation Lead at the global design and engineering consultancy, Buro Happold, I am also studying for a PhD in Design at Imagination Lancaster, a research unit of Lancaster University. Prior to undertaking this study, I worked for several years across east Africa with

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Franziska is a Senior Teaching Fellow in Design at the University of Southampton teaching Design in a multi-disciplinary context to engineering students. She is a product designer and accomplished entrepreneur with 19 years' experience of design experience. She has a passion for Nature Inspired Design (NID) and has completed specialised Biomimicry training. Her PhD research is focussed on embedding NID in design education and enhancing students understanding of sustainable design practice.
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