Embedding a strengths-based approach in humanitarian engineering research through reflexive practice

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***Abstract**: Humanitarian engineering (HumEng) often draws on strengths-based approaches (SBAs). However, this concept remains undefined in HumEng literature. This paper presents analysis of a collaborative reflective practice we undertook in parallel with PhD scholarship to explore what SBAs mean within HumEng and embed them in our HumEng work. In this process we discussed themes of engineering identity and problem-solving mentalities, power dynamics across a research process, theories for research in humanitarian engineering, deficit terminology, and more. SBA tools and activities aided our process, allowing us to trial practical applications of an SBA across our research process. Through our journeys, we explored the empowering and transformational qualities of SBAs, which we present in this paper. We emphasise that SBAs should not be seen as toolbox approaches, but rather as a philosophy that can be incorporated on both professional and personal levels. We present our model for embedding an SBA through reflexive practice, and we encourage others to consider the potential, and the importance, or both reflexivity and SBAs.*

Keywords: Strengths-based approaches, reflexive practice, problem solving, engineering identity, humanitarian engineering research

1 INTRODUCTION

Engineers are frequently described as "problem solvers"; this is both a key aspect of engineering identity as well as a core approach to engineering (Arshad-Ayaz *et al*., 2020). However, the problem-solving mentality is not necessarily effective in all contexts (Farrell, 2011; Mitchell *et al.*, 2015). Values, structural norms, and processes of knowledge production contribute to how an individual understands a situation and what they think is a possible solution (Cech, 2013; Arshad-Ayaz *et al.*, 2020). As these factors can change dramatically between contexts, engineers may need to examine their encultured approach to problem-solving

to work effectively in new settings. Identifying appropriate "solutions" often requires engineers to move away from what they perceive as objective problem solving, engage with different mindsets or worldviews, and examine power structures and complex contextual factors. This is particularly relevant for humanitarian engineering (HumEng) where "problems" transcend borders, are subjective, and are tied intrinsically to human beings and complex lived experience (Mazzurco and Daniel, 2020). In this paper, we follow Smith *et al.*'s characterisation of HumEng in Australia (2017) as the application of engineering within a humanitarian or development context (not limited to disaster relief or "Global South"/low- and middle-income countries) requiring additional knowledge, skills, attitudes and competencies as well as disciplinary knowledge.

In this paper, we share our journeys of embedding strengths-based approaches (SBAs) in our HumEng research through a process of reflexive practice. SBAs centre the assets, capabilities, successes, visions, and hopes of an individual or community (Kretzmann and McKnight, 1993; Saleebey, 2000, 2011; Willetts *et al.*, 2014). By elevating community/individual capabilities and letting expert knowledge take a supporting role, SBAs work to disassemble power structures and assumptions of knowledge between researchers and participant-collaborators (Willetts *et al.*, 2014). These sentiments are in contrast to prevailing expert-led, technocratic approaches in engineering and development (Du Pisani, 2006; Bull and Bøås, 2012; Kilby, 2012; Cech, 2013; Arshad-Ayaz *et al.*, 2020) which look for deficits or divergence from Western, modernist ideals that can be fixed by external experts. However, though there are many SBA tools and activities available (as explored in Section 2), disassembling power structures, assumptions of knowledge, and engineering identity requires deeper reflexivity than a "toolbox" approach can provide.

The reflexive practice described in this paper leads us to the position that SBAs are essential for engineers to look beyond needs and problems and engage with the transformative potential of engineering practice to serve society. Though we approached this journey as PhD scholars in HumEng, we see research and practice as inextricably intertwined given the applied nature of HumEng research (c.f. Mitchell *et al.*, under review). Our reflexive process (Section 2) drew on our diverse practical experiences in engineering, community development, global water and sanitation, and HumEng education. Our range of experience meant we were also at different points in our journeys to embedding an SBA. Leandra was new to SBAs but saw their potential for her research. Elia had prior experience exploring SBAs primarily in her undergraduate studies but had not considered SBAs in a research context. Anna had experience applying SBAs in community partnership roles and was already working to embed the approach in her engineering work and research. For our expanded positionality statements, please refer to Mitchell *et al.* (under review). We share our journeys to demonstrate and encourage a shift away from problem- and deficit-framing towards an engineering philosophy that facilitates deeper mutual understanding, and supports participant-collaborators to actively shape their own futures.

After exploring the philosophy of SBAs and their centrality to HumEng in the literature review below, Section 2 outlines our reflexive practice and the SBA tools we applied. Section 3 explores key themes that emerged through this process: a recognition of challenges and problems as valid experiences, the enculturation of problem solving and technical skills as central to engineering identity (but problematic for HumEng research and practice), and the power of an SBA as a philosophy rather than a toolkit. Sections 4 and 5 provide our recommendations for implementing an SBA in research and for developing a reflexive practice to embed an SBA philosophy.

1.1 **What are SBAs?**

SBAs are ways of facilitating and enacting change by nurturing and expanding the strengths that already exist within an individual, organisation or community, rather than approaching change through problematisation and pathologising. They are a family of approaches that have developed in a range of disciplines, with variations for individual and community development: the strengths perspective in social work and psychology (Saleebey, 1996, 2000, 2011); positive deviance, emerging from sociology but applied more frequently in medical research and practice (Herington and van de Fliert, 2018); appreciative inquiry in organisational change (Bushe and Kassam, 2005); and participatory approaches like Asset-Based Community Development (ABCD) in community and international development (Kretzmann and McKnight, 1993; Willetts *et al.*, 2014; Cunningham *et al.*, 2022).

The transformative potential of SBAs is a key theme that spans disciplinary boundaries. (Refer to Willetts *et al.* (2014) for a more detailed review of SBAs across disciplines). SBAs recognise individuals and communities as experts in their own lived experience, capable of leading their own change (Saleebey, 1996, 2000, 2011; Bushe and Kassam, 2005; Cahill, 2010; Willetts *et al.*, 2014; Herington and van de Fliert, 2018; Price *et al.*, 2020; Toros and Falch-Eriksen, 2021; Cunningham *et al.*, 2022). Individuals and communities are supported with the skills, knowledge and resources to make change by identifying strengths – assets, capabilities, hopes, visions, successes – and the relationships that exist to mobilise them (Kretzmann and McKnight, 1993; Saleebey, 2000, 2011). A change process based on SBAs is empowering as participant-collaborators recognise and act on strengths and relationships to bring about desired change. This process is transformational in opening up a completely new way for participant-collaborators to understand their role in a change process (that is, their understanding of their role is transformed). The outcome of a change process can similarly be transformational as SBAs may stimulate new ideas for ways of doing things.

Fostering empowerment and transformation through SBAs requires two fundamental beliefs from practitioners, and in the context of this paper, researchers (Willetts *et al.*, 2014):

1. They believe and value that every individual has innate capabilities, life experience, and characteristics that can contribute to development outcomes, and that any

community or environment is rich in resources or assets including individuals, associations, institutions, and natural and built environments.
2. They see themselves as facilitators and not the "experts" on what changes are needed or the best ways to achieve them.

In other words: to foster empowerment, facilitators must reflect on their own power, recognising individuals and communities as the expert in the situation. The "expert" relinquishes their "power over" the situation, fostering the individual or community's agency, "power to" or capacity to enact change (Saleebey, 2000; Cahill, 2010). As we explore in Section 3.2, this does not mean ignoring the broader processes that create social inequalities and power imbalances. See Mohan and Stokke (2000) for a useful discussion on power and empowerment in participatory development. Therefore, the process of embedding SBAs is transformational for both facilitators and participant-collaborators as they integrate new ways of understanding and being into the change process (akin to a threshold concept in education literature e.g. Cousins (2015)).

1.2 **Humanitarian engineering: A strengths-based engineering practice**

HumEng often draws from SBAs, at least within the Australian context. This approach reflects the role that Engineers Without Borders Australia (EWBA) has played in building the HumEng movement in the region (as evidenced by the origins of this journal). EWBA has largely worked in the sphere of community development. As a result, EWBA has adopted principles and practices from community development to govern its engineering work, including SBAs (EWBA, no date). EWBA's work in building the HumEng sector has consequently included SBAs as core to HumEng practice. Yet, we were surprised to find limited *research* exploring the role of SBAs within HumEng; a Google Scholar search (with terms humanitarian engineering and strengths-based approaches) returned only 11 results. This suggests that while SBAs are used in HumEng projects, an evidence base is not readily available to support practitioners in their work. Mazzurco (2016) similarly notes in his PhD dissertation on participatory HumEng that while SBAs are embedded in HumEng practice (emerging as a "core concept" of HumEng in practitioner interviews), they are not "fully unpacked" in the literature.

Where HumEng literature has engaged with SBAs, SBAs are not consistently defined and are applied in varying ways. Gan *et al.* (2018) note SBAs within the description of a HumEng curriculum for human-centred design, and Brown *et al.* (2016) associate SBAs with community engagement in a survey instrument for assessing undergraduate professional engineering skills, implying SBAs are an indicator of good practice. Johnson *et al.*'s (2021) work, while explicitly centring SBAs (and context-driven solutions) in their definition of HumEng, remains similarly non-specific. They associate SBAs with the use of culture, history, geography, and traditional community knowledge to inform engineering solutions, but do not define SBAs. These non-specific and variable definitions suggest that while researchers, educators and practitioners do value SBAs in HumEng, there is a risk that SBAs may be misunderstood, applied incorrectly or used instrumentally as a way to achieve project efficiencies.

Though Asset-Based Community Development (ABCD) is one of many SBAs, HumEng practitioners view SBAs and ABCD synonymously (Mazzurco, 2016). ABCD has its origins in participatory development, which emerged in the 1980s as an alternative to top-down development approaches: participatory development is a "sharing-empowering" approach that emphasises "ownership of plans, actions and projects" by local people (Chambers, 1994). Aligning with this paradigm, ABCD centres community members as "principal actors in the development process" (Cunningham *et al.*, 2022). In ABCD, community members:

"decide, plan and act to progress their own development goals, using their existing individual and collective strengths and capacities ("assets") ranging from material (e.g. land, finance) to less tangible assets (e.g. skills, institutions)." (ibid).

This approach requires the researcher/practitioner to privilege the knowledge and experience of a community, shifting power from expert to community or individual.

Community engagement, inclusive design, and traditional community knowledge are foundational for HumEng (Mazzurco, 2016; Johnson *et al.*, 2021), but the transformative and empowering potential of SBAs drawn on in other disciplines has not yet been described within HumEng field of research. Researchers and practitioners in HumEng, it would seem, have the opportunity to further explore what SBAs are or can do (namely empowerment and transformation) to strengthen the theory and application of SBAs within HumEng. Ultimately, greater theoretical development of SBAs within HumEng may assist the sector to tap into potential of SBAs as a tool for empowerment.

2 METHODOLOGY

Embedding an SBA requires that we consider our encultured methods developed through our engineering experiences to examine how these influence our approach to HumEng. Reflexivity is considered a necessary and on-going process for researchers to articulate their positionality, understand their role in their work, and ensure ethical research (Cunliffe, 2009; Holmes, 2020). As such, we see reflexive practice as an important technique for HumEng. We adopted Cunliffe's model (Cunliffe, 2009) for reflexive practice to facilitate our journeys in becoming reflexive researchers and in embedding an SBA across our research processes research.

Cunliffe (2009) notes a difference between reflection and reflexivity, emphasising that reflection of self cannot be accomplished objectively. Reflexivity and reflexive practice are required to enhance the process of reflection. The author specifies a need for both critical reflexivity (outward critique of ideologies and practices) and self-reflexivity (inward critique of our role in shaping realities and meanings). Cunliffe's model (Cunliffe, 2009) for reflexive practice includes:

- Reflex response: an initial or instinctive response to a situation
- Reflection: a purposeful (re)consideration of a reflex response
- Reflexive practice: a practice to continuously unpack and question assumptions that inform our reflex responses and reflections

We used this model in structured reflexive practice sessions where we drew on our backgrounds, positionalities, and previous experiences in HumEng. In reflecting on these components of our identity, we also identified opportunities for HumEng broadly.

2.1 **Reflexive practice sessions**

We organised nine reflexive practice sessions which incorporated collaborative journaling (Mackenzie *et al.*, 2013); these sessions were planned so as to meet the deadlines of this Special Issue. Sessions were 2 hours and followed the structure outlined in Table 1. We traded the role of facilitator for each session, allowing each of us to pick a theme, create writing prompts, and lead the group discussion and activities (outlined in Table 2). Sessions explored themes of engineering identity, theories and approaches used in HumEng, power dynamics and perpetuation of colonial mindsets, and ways to embed an SBA in our research practice. Most sessions incorporated a specific SBA tool, activity, or technique (referred to as tools from here on) to support us in embedding an SBA.

Table 1: Structure of each 2-hr reflexive practice session

Stage	Method	Duration
1. Reflex response	Journaling • Individual prompts provided by the session facilitator ahead of time	30 mins
2. Reflection/Reflexivity	Discussion • Collaborative reflection on prompts and/or group activity led by session facilitator	60 mins
3. Reflection/Reflexivity	Journaling • Free writing or with prompts depending on session facilitator	30 mins

We collected data in two ways: 1) through individual journals to log our written responses for each reflexive practice session (e.g. responses to writing prompts) and 2) through recordings of group discussions. For the purposes of this paper, all recordings were transcribed, and we individually reviewed and thematically coded both transcripts and journal entries using an inductive approach. We then collaboratively analysed and reflected on our coding to yield key themes.

Table 2 outlines the activities we conducted in each reflexive practice session and the SBA tools we used. The Appendix outlines additional details of these sessions, including our journal prompts, for those interested in starting their own reflexive practice.

Table 2: Reflexive practice session themes and SBA tools trialled

Session theme	Session activities	SBA tool and description
1. What is HumEng and engineering identity?	We reflected on some of our previous professional and educational experiences	Reflective prompts: e.g., "when were you most effective?" adapted from EWBA training resources (EWBA, 2017) • Indirectly prompts participants to share their strengths • Other participants reflect on the answers, identifying and appreciating strengths and capacities
2. What paper has been most influential?	We explored the change we have seen across our research process to date, specifically in relation to an influential publication	Most Significant Change • A story-based approach often used in development projects to emphasise what people value • Allows knowledge holders to speak about their experiences and the things

		that are most valuable to them (Dart and Davies, 2003)
3. Theories, tools, and assets in HumEng research	We constructed individual asset maps to consider the values, skills, tools, knowledges, and networks we have available to draw on in our research We also mapped these assets based on their influence and importance	Asset mapping • Prompts participants to identify existing community and individual strengths or assets (e.g. natural, organisational, and personal assets as described in Kretzmann and McKnight, (1993))
4. Global North/Global South and consequences for HumEng	We discussed notions of community domestically and internationally	Self-visualisation/translocation exercise • A thought experiment to imagine your response if someone else applied a deficit-based approach to something you cared about • Assists participants to explore the feeling of SBAs and how they support trust and relationships
5. Coloniality – power, benefits, and language	We unpacked stakeholder power dynamics in our research projects, the distribution of benefits, and the perpetuation of colonialism Note: SBAs are often critiqued for not engaging with power within communities (c.f. Gray, 2011)	Strengths-based reframing • Prompts participants to consider the language they use and to reframe by highlighting assets or using strengths-based terminology • We used it specifically with the example of strengths-based fundraising
6. Participatory approaches and SBA	We explored participatory approaches and discussed the differences between "power over" and "power to"	No specific SBA tool was used. The activity prompted us to consider the intrinsic and instrumental goals of participation (Mansuri and Rao, 2013) and how these align with SBAs.

7. Embedding an SBA within our research practice	We considered the supports and enablers we would need to embed an SBA in our research practice	Practitioner reflexivity prompts: e.g., head/heart/hands adapted from EWBA training materials (EWBA, 2017) • Prompts the participant to reflect on different thoughts and feelings with action orientation • What is in my head? (intellectual thoughts) • What is going on in my heart? (emotional responses) • What can I do with my hands? (what are the practical steps I can take?)
8. SBA in your research	We explored our motivations for embedding an SBA and mapped examples of how we are using SBAs within our PhD research.	No specific SBA tool was used.
9. Reflection on the reflexive practice	We reflected on our process of reflexive practice, the methods we used, and the change we experienced	Most Significant Change

3 THEMES UNDERPINNING OUR JOURNEY TO EMBEDDING A STRENGTHS-BASED APPROACH THROUGH REFLEXIVE PRACTICE

This section presents emergent themes from the reflexive practice sessions. While empirically drawn from our own experiences and backgrounds (introduced in Section 1), these themes necessarily reflect the interplay between individuals (in this case, ourselves) and the structures of HumEng. Our reflexive practice sessions prompted us to interrogate engineering identity formation (Section 3.1) and the role that HumEng plays as a bridge to embedding SBAs. Section 3.2 synthesises the opportunities we see for HumEng to more deeply embed SBAs as an underpinning philosophy.

3.1 What a strengths-based approach is not: (Humanitarian) engineering and the problem with problem solving

The initial motivation for this paper was borne out of a seeming disconnect in HumEng. SBAs often form part of HumEng discourse. SBAs are listed as one of EWBA's key principles (EWBA, no date). They are also embedded in HumEng university courses e.g. through EWBA's "EWB Challenge" program delivered to approximately 10,000 first year engineering students across approximately thirty universities in Australia and New Zealand each year (EWBA, 2020).

However, as we started to explore the concept of SBAs, we encountered dissonance between the ideals of SBAs and the institutions of engineering. The Engineers Australia HumEng

Community of Practice, for example, uses deficit-based identity terms such as "disadvantaged" and "vulnerable" to characterise communities (Engineers Australia, no date). Even the idea of engineers as problem solvers starts with the premise that there is a problem to solve. On the other hand, we cannot deny that people do experience disadvantage and vulnerability. A surface-level application of SBAs risks shutting down space to explore genuine challenges as defined by participant-collaborators. This cognitive dissonance challenged us to explore what might be possible by more deeply embodying SBAs.

The embedded engineering identity

We are drawn to HumEng and SBAs to connect engineering more deeply with its potential to positively contribute to society and community-led impact. However, our initial experiences at university and in industry defined engineering by technical skills and their application to problem solving. Leandra's engineering studies at Canadian universities were accompanied by a series of indoctrinating rituals to stress the importance of problem solving, but notably stopped short of linking to positive social impact. Cech (2013) finds that these approaches embed a meritocratic ideology within engineers that prevents them from seeing a role for themselves in supporting and expanding social justice. While absent of rituals, the problem-solving rhetoric also featured strongly in both Elia and Anna's studies at Australian universities. In industry, we associated feelings of competency with technical effectiveness. As Anna notes, "*I was employed for my engineering expertise and in order to be successful... I needed to contribute and be respected for my technical knowledge and skills."* These experiences exemplify the fundamental connection between engineering identity and problem solving, also noted by Arshad-Ayaz *et al.* (2020).

Technical skills are of course fundamental to engineering practice. However, engineering is inherently an applied profession. Rather than the goal, technical skills are the tools we use towards our professional duty of "*serving society*". This reframing prompts us to think critically about how we define the problems engineers solve. For Anna, this is foundational to her engineering identity: *"what gives my professional engineering identity meaning is that engineers use maths and science to solve problems that contribute positively to society… fundamentally, the solution can only be technically sound if the problem is framed in a way that is relevant to society".* Moving beyond problem solving requires creativity and deep and holistic knowledge of context beyond solely technical competence. As Elia notes, this is sometimes forgotten in industry: "*while there was occasional lip-service to social and environmental responsibility, decisions were always driven by budget bottom lines".*

Beyond technical – valuing differing knowledges and engaging with power through humanitarian engineering

We see HumEng as an opportunity to incorporate elements of engineering identity beyond problem solving and technical skills. For Leandra, this includes "*embracing complexity"* to meaningfully explore intersectional factors in the water, sanitation, and hygiene sector (WASH). Similarly, Elia feels able to "*put social and environmental responsibility at the core of practice"* through her HumEng PhD. For all of us, it means embracing multiple types of knowledge, such as Indigenous knowledge systems and knowledge developed through lived experience, particularly from community collaborators. We recognise this comes with challenges: for one, these knowledges are not always readily accepted by dominant academic systems (Norström *et al.*, 2020). Through reflexive practice, we have explored multiple

framings and approaches to help us engage with different knowledge holders, such as providing spaces for knowledge holders to take part in, welcoming significant levels of participation, and joining existing, community-owned spaces where appropriate (noting that who convenes a space will influence the power dynamics (c.f. Gaventa, 2006)). Additionally, we see a need for community to have a say in *how* they participate, which considers burden of representation and consultation fatigue.

As PhD scholars in HumEng, we can choose to critique the power dynamics that we see in our projects and our sectors. Researchers have the opportunity to hold power to account, questioning institutional power or metrics in publishing ('Anti-Racist Scholarly Reviewing Practices: A Heuristic for Editors, Reviewers, and Authors', 2021). In observing and critiquing the ecosystems of power that we navigate in our research, we are able to reflect on current systems and be conscious to engage critically. For community-facing research in particular, researchers need to be confident enough to cede control and be led by community priorities. However, we must remain conscious of power dynamics within communities when applying SBAs (c.f. Gray, 2011). Reckoning with these tensions is easier said than done, particularly for PhD scholars who may be constrained by institutional requirements. While the mechanisms for navigating community-led PhD research may not be obvious, we challenge ourselves to seek these out (e.g. action research methods) or develop and try our own.

An evolving humanitarian engineering identity

HumEng can mean different things to different people, at times mobilising problematic ideologies. From different engineering disciplines, career stages, and geopolitical contexts, we each brought to our discussion different understandings and alignments with the field we have agreed to call "HumEng". Leandra's initial reaction was quite a visceral response driven by her upbringing in Canada and experience in both international development and WASH. Among her professional network, "humanitarian" is associated with "white saviour complex", top-down and colonialist approaches to development with limited contextual consideration, and narrow definitions of social impact (excluding ecological considerations) which inhibit sustainability and cause harm.

Anna's first exposure to the concept of HumEng was through awareness of Engineers Australia's "Year of Humanitarian Engineering" which seemed to focus primarily on international contexts, and the EWBA's Redefining Engineering as a Humanitarian Profession campaign seeking to emphasise linkages between engineering and the positive impact the profession can have for people. Working to decarbonise Australia's energy supply through renewable energy deployment, while positioned within an environmental impact, Anna felt a direct link between climate change and its impact on people, particularly as those less responsible for climate change would bear its worst impacts. Anna viewed her engineering role as positioned within this HumEng framework, strengthened by the responsibility she felt as someone who had benefited from carbon emissions. This aligned with earlier understandings of engineering as serving society; HumEng simply reflected engineering, at least the engineering she hoped to contribute to.

Elia's understanding of HumEng was initially shaped through HumEng courses in her undergraduate studies, which as default emphasised the importance of factors beyond the technical. She strengthened and applied these more holistic approaches to engineering through international collaborative learning experiences. As COVID-19 travel restrictions prompted her

to relocate her PhD topic from the Pacific to Australia, this also prompted reflection on where HumEng can occur. Her experience of HumEng had always been something that happens "over there" yet she found that the holistic approaches she had learned through HumEng were equally applicable to an Australia-based investigation.

Our reflexive practice, with a focus on the role of SBAs in HumEng, took us on an exploration of our professional identity - what it means to be an engineer, to be a humanitarian engineer, and to be a HumEng researcher. We found that SBAs opened up space to bring in holistic approaches, reflect on power, and redefine the boundaries of the problem. In turn, this opened the boundaries of the solution space. Through this exploration, each of us became more comfortable with describing what we do as "HumEng" (and as "HumEng researchers" within our PhDs) as we developed a shared understanding of what we meant by this term. We remain alert to the potential ways that "HumEng" can be co-opted to justify potentially harmful approaches. However, this process of exploring HumEng has been a mechanism for each of us to develop and strengthen our identities as researchers in HumEng. Key to this process was reflecting on the idea of engineers as problem solvers, thinking about the tools required to dislodge this idea and open up to different ways of seeing and being. We consider this as crucial for continual reflexive practice. We encourage the HumEng community to join us on this journey to strengthen the process and impact of HumEng work.

3.2 What strengths-based approaches can do: Embedding an SBA philosophy

SBAs have a transformational agenda for communities and the people who work with them. In building from assets and capacities rather than focusing on what seem to be missing, SBAs can catalyse changes in participants' self-perception from in need of help to someone with the important skills and knowledge to shape change within their own context (c.f. Cahill, 2010). They also ask practitioners to similarly change the way they perceive and engage with communities they are working with (Kretzmann and McKnight, 1993; Willetts *et al.*, 2014). As an example, we recognise the transformational potential of SBAs as a step in the process of decolonising research (c.f. Tuhiwai Smith's Indigenous Research Agenda (2012) identifies psychosocial transformation as key for achieving its aim of self-determination, that is , communities' ability to making decisions about their own futures). We recognise that self-determination is only one part of the decolonising process (Tuck and Yang, 2012). This section focusses on what is necessary to support the transformation that underpins the tangible outcomes of community-led change.

Embedding and embodying a strengths-based approach: Beyond the toolbox

There are many SBA tools available to practitioners and researchers to adapt and incorporate SBAs into a project. In this process we explored a number of these tools (see Table 2) and reflected on how they might apply to our research projects (see Section 4). This approach was useful for building practical experience with SBAs. On one hand, it was clear through our reflexive practice process that tools provide mechanisms for transforming the experience of research for both ourselves and our community collaborators, e.g. through eliciting community priorities, valuing lived experience, and empowering community members to influence the direction and methods of our research projects. However, we could also see that using these tools *alone* may not achieve the intended transformational impact of SBAs. There is a risk that

the toolbox approach creates the opposite effect through superficially applying SBA tools to justify external agendas (recognised in participation literature, c.f. Cooke and Kothari (2001)). We emphasise here that SBAs are *approaches;* facilitators need to do the work to move beyond selecting and applying tools to embodying an SBA philosophy. As Elia noted: "*A strengths-based approach can't be reduced to a "recipe" of activities*".

Tools are an entry point to developing an SBA *"philosophy*" or *"mindset"*. Through our reflexive practice, we took on the role of "participants" of an SBA project; while we were seeking change in our practice, we started to see the start of a transformation in ourselves. While this transformational journey is ongoing, we emphasise the following highlights so far.

SBAs are personal. Applying SBA tools to ourselves evoked the feelings that might be triggered when participants experience deficit- and strengths-based approaches. We started to internalise SBAs on an emotional as well as an intellectual level, generating empathetic solidarity with our potential participants. This reinforced the opportunities we have throughout our research process to establish trust and collaboration with human beings rather than research participants. To better capture the collaborative intent, we adopt "participant-collaborator" to recognise a more equal and co-creationist approach to people involved in our research (noting that many other disciplines have made similar language shifts for similar reasons c.f. interlocutor in anthropology).

SBAs don't deny challenges. A number of our initial discussions centred on the apparent conflict between SBAs and identifying challenges that communities might face. This is a common misinterpretation of SBAs. In light of the engineering problem-solving identity, it might be one that engineers in particular grapple with. Rather than denying the genuine challenges a community might face, start and remain open to exploring strengths rather than diagnosing challenges. Further, acknowledging reality - including a challenging, problematic, or unpleasant reality - can actually reflect an SBA (and as Johnson (2013) shows, can provide energy for action). Anna reflected that "*SBAs [are] a way of redescribing or re-understanding barriers - the barriers that we place on ourselves, as well as the ones that are beyond our control.*" As Askew *et al.* (2020) described in their paper on SBAs in public health for Indigenous groups in Australia, SBAs did not deny challenges, but "*attempted to disentangle the problems that Indigenous peoples experienced from the notion that Indigenous peoples were the problem*". In doing so, SBAs provide space for a more nuanced exploration of positive and negative experiences (Michael, 2005).

SBAs offer a new way of seeing and describing the world. The process of appreciating others' strengths has an impact on the way we think and feel. The positive energy that comes from recognising strengths in others and ourselves is enriching and sustaining. We noted that words like "beauty" and "love" came into our descriptions and reflections. These are words that had limited use in our earlier experiences in the engineering sector. This reflected a shift towards engaging more holistically with the full range of human experiences in our research, a key part of HumEng research (Mitchell *et al.*, under review). While technical skills tell us what problems we can solve, SBAs help us see what opportunities there are to contribute positively to the world.

These points reflect our journey from positive reframing to embedding an SBA philosophy. Together, they hint at the potential an SBA can have in opening up the field of HumEng. Building from the idea that SBAs are a "core concept" of HumEng, we offer the following principle that reflects how we hope HumEng research can change by embedding and embodying an SBA.

A strengths-based approach to HumEng research is empowering and transformational for participant-collaborators and researchers; it facilitates deeper mutual understanding, blurs the distinction between "helper" and "helped", sees participant-collaborators as full human beings and values the lived experience they bring to the research process. It is a celebration of humanity, beauty, and opportunity.

4 PRACTICAL IMPLEMENTATION OF A STRENGTHS-BASED APPROACH ACROSS THE RESEARCH PROCESS

In our penultimate reflexive practice session (Table 2), we applied our strengthened understanding of SBAs to exploring how SBAs emerge within our research processes. In this section, we offer key themes from this exploration to assist other researchers with operationalising an SBA and specific examples of how these themes manifest in our research (see Figure 1)

A first and obvious theme is reflexivity as a practice to support an SBA. In Section 5, we offer recommendations to develop a collaborative reflexive practice, but individually this could be as simple as continually asking: how am I applying an SBA, does this reflect an SBA?

As explored in Section 3.2, opportunity framing emerged as a key action to move away from problem-focussed research and demonstrate an SBA. For scoping and developing research questions, this can be as simple as asking about participant-collaborator "perceptions" or "experiences" of a situation rather than explicitly searching for "challenges" or "barriers". Such framing is also relevant to literature review: consider the deficit approach inherent in searching for research "gaps". While we do not dispute that research should create new knowledge, the continual focus on what is missing, erroneous, or overlooked in the literature misses the opportunities for new knowledge opened up by using an SBA. By opportunity framing in early phases of research, we establish the basis for analysis that looks beyond the barriers and challenges a participant might identify, focussing instead on their experiences, strengths, or capabilities to address them.

Valuing diverse knowledges was also key. In early phases of research, this means using literature from a range of disciplines, looking beyond academic literature, and valuing researcher and participant lived experience as valid knowledge. Our core principle centres participant-collaborators as "full human beings" and values the knowledge and lived experience they bring to the research process. As we noted in Section 3.2, for us this means finding ways to cede control of research processes to community and collaborators. This could mean involving participant-collaborators in research planning, using open-ended or unstructured methods to allow participants to emphasise their priorities, collaboratively interpreting results or (at a minimum) validating results with participant-collaborators, or deciding together what research outputs are valuable to community partners. Impactful outputs go beyond formal academic papers (Mitchell *et al.*, 2015) and should explicitly acknowledge and celebrate the contributions, knowledges, and strengths of participant-collaborators.

Networks and collaborators are also key, a) to support reflexivity and b) to collectively develop an SBA to HumEng research and foster academic cultural shifts to embrace the approach. For example, we participate in an "Engineering + Impact" reading group with HumEng PhD scholars, and we find the welcoming yet intellectually challenging environment fosters collaborative and individual reflection on creating meaningful impact. Community partnerships (a feature of much HumEng research (Mazzurco, 2016)) offer a further collaborative environment in which to develop and embed an SBA.

As PhD scholars, we see supervisory support for SBAs to be essential, particularly as SBAs challenge (some) entrenched academic and engineering disciplinary norms: what is a research question (not a problem), what is good literature, collaboration as research approach, acceptance of alternative epistemologies, and the development of non-academic/accessible/creative research outputs as the norm. That some supervisors take a proactive approach to fostering an SBA reflects that a shift in academic culture is already occurring. We see the growth of SBA as a research approach as essential to impactful HumEng research and encourage researchers who apply an SBA to elevate and celebrate this in their outputs, demonstrating other SBA models for researchers to follow.

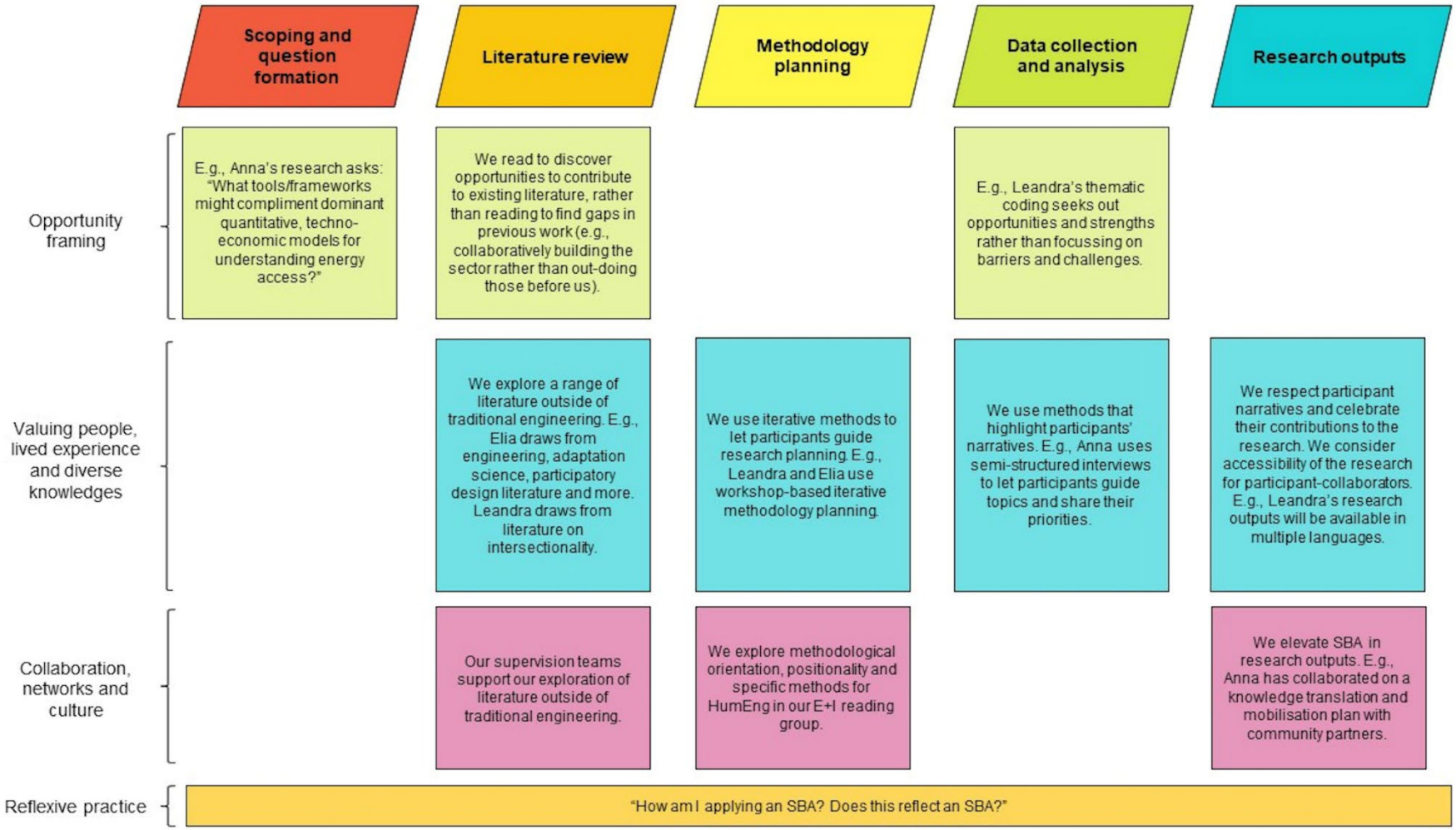

Figure 1 Examples of SBAs in our research

5 PRACTICAL IMPLEMENTATION OF REFLEXIVE PRACTICE

Through our process, we have generated insights on reflexive practice as well as SBAs in HumEng. Our reflexive practice was shaped to meet the deadlines of this Special Issue: we were only able to trial one model of reflexive practice (as outlined in Section 2), and we expedited a long and on-going process. Because we are a small group of peers, at similar stages of candidature and with existing relationships, we did not have to consider significant power imbalances and could easily create a space for us to be vulnerable. An additional consideration was that we made our reflexive practice sessions explicitly collaborative. While others might engage with reflexive practice on an individual level, we found that collaboration was one of the more transformational aspects of our practice. Acknowledging these, we offer the following recommendations for anyone hoping to develop a collaborative reflexive practice.

- *Curate a collaborative, welcoming, and open-minded space:* Our reflexive practice sessions required welcoming mindsets; trust and respect were key in allowing us to reflect and interrogate mentalities in a group setting. We recommend that attention be paid to curate psychological safety, ensuring that people are welcoming, compassionate, open-minded, and respectful. We believe that this is a foundational aspect of the process to ensure participants can engage meaningfully and without judgement. This could be done through explicit discussion and agreement on behaviour and engagement practices (e.g., listening without interrupting); participants should be aware of these expectations prior to sessions. Small groups (e.g. no more than 5 people) may help discussions and ensure everyone in the group has a chance to reflect.
- *Ensure all participants are aware of expectations*: An opt-in approach may be necessary to ensure that all participants are eager and genuinely interested in doing the work. Additional planning may also be necessary to detail the kind of environment that would be expected. Ethical considerations might also need to be accounted for such as conflicts of interest.
- *Prepare specific methods:* We emphasise the benefits of having a designated facilitator and starting prompts for each reflexive practice session. In trading the role of session facilitator, we were able to explore diverse themes, and starting prompts allowed us to individually gather our thoughts before actively engaging in the session. In most sessions, we applied specific SBA tools (see Table 2) which allowed us to trial practical applications.
- *Allow time to digest and absorb:* The collaborative nature of our reflexive practice allowed us to explore concepts we might not have otherwise considered. Therefore, time to digest was often needed. We recommend that there be time allocated at the beginning and end of each session for further reflexivity, summing up key takeaways at the end of each session to reflect on at the beginning of the next. This allows participants space to explore ideas that may have arisen since the last discussion.

6 CONCLUSION

"I think [SBAs have] had a transformational impact on my life and the way that I see the world" - *Anna.* We embarked on this process to engage with the disconnect we have experienced between ideals and practice within HumEng, challenging traditional problem-solving mentalities and deficit approaches. Along our journeys, we came to discover the empowering and transformational qualities of SBAs. We present these qualities in this paper as we believe

that the transformational opportunities of SBAs have not been adequately captured in HumEng literature to date. Throughout this process, we have engaged with discourse around engineering identity, finding that SBAs allowed us to clarify and expand our notions of HumEng. We believe that HumEng provides a space to progress beyond problem-solving mentalities and embrace holistic approaches. We strongly suggest that HumEng, underpinned by SBAs, is increasingly necessary for good engineering practice.

Though SBAs are traditionally adopted to empower individuals and communities, building on existing assets to alter perceptions of and within these individuals and communities, we have applied SBAs to ourselves and our research through reflexivity. We created an environment of compassion and collaboration where we could explore how to implement both an SBA and reflexive practice. In our reflexive practice sessions, we challenged ourselves to think through power, positionality, and mindsets, and how each of these inform our research. By engaging with reflexivity throughout this process, we have also modelled the importance of being reflexive researchers and practitioners with recommendations on how to develop an on-going reflexive practice.

We have presented a model for how others might embed an SBA in themselves and their work, including SBA tools and activities that we incorporated into our reflexive practice. We also provided examples for implementing an SBA across a research process. We emphasise, however, that this is not a toolbox approach: we encourage others to consider an SBA philosophy as opposed to appropriating SBA tools to achieve specific agendas.

Professionally, this process has shown us the synergies between SBAs and our work, and it has helped us gain a sense of agency in applying an SBA in our current research projects. On a personal level, we have also found that SBAs resonate with how we want to live our lives and support our friends, colleagues, and ourselves. We acknowledge that our journeys to embed an SBA are ongoing, and we encourage others to also explore the celebration of humanity that SBAs can provide.

7 AUTHORSHIP STATEMENT

All authors contributed equally.

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