PUBLISHED VERSION

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Published at:
https://aaee.net.au/?s=Exploring+the+Position+of+Humanitarian+Engineering+in+Australia

https://hdl.handle.net/2440/137401

33rd Annual Conference of the Australasian
Association for Engineering Education (AAEE 2022)
4 - 7 December 2022 – Sydney, NSW

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Exploring the Position of Humanitarian Engineering in Australia

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ABSTRACT

CONTEXT

The position of an engineering field, such as a discipline, specialisation, or area of practice, reflects the body of knowledge, skills and techniques required to practice. Humanitarian Engineering, which was recognised with a 6-digital Field of Research code in 2020, works within a range of contexts and communities where there are inherent power imbalances, and decisions and actions that affect immediate livelihoods and wellbeing. This can be considered similar to fields within Engineers Australia such as *Amusement Rides and Devices* (an area of practice) and *Fire Safety* (both an area of practice and technical society). These fields do not have large memberships, but are sufficiently specialised and high risk to require dedicated scrutiny. Humanitarian Engineering can be considered to warrant similar levels of enhanced scrutiny of its practice and education.

PURPOSE

The Engineers Australia Humanitarian Engineering Community of Practice have devised a six-item agenda for the professionalisation of Humanitarian Engineering in Australia. This seeks to bring the same level of rigour, review, and recognition to Humanitarian Engineering as for any field, area of practice or discipline of engineering. This study set out to determine a broad consensus on the position of Humanitarian Engineering within existing frameworks in response to the agenda.

APPROACH

The study adopted a modified Delphi method in which key stakeholders and representatives of Humanitarian Engineering education and practice in Australia were invited to a workshop to openly discuss and debate the position of Humanitarian Engineering in Australia. A pre-workshop survey established a starting point for discussion at a 2-hour workshop while a post-workshop survey identified and tested key insights and findings.

OUTCOMES
A specific position on Humanitarian Engineering in Australia was not reached during the workshop. Rather, underlying assumptions were challenged and tested. Humanitarian Engineering was indeed considered to need higher levels of review and accountability, underpinned by key values and principles. A more specific set of next steps were identified in order to address unresolved questions and provide further analysis to support a potential position.

RECOMMENDATIONS

Humanitarian Engineering education and practice should be subject to a high level of scrutiny to ensure appropriate education and practice. Regardless of a specific position and definition, further discussion and critique from within and outside engineering in Australia must continue.

KEYWORDS

Humanitarian Engineering, Professional Practice, Engineering Accreditation

Introduction

Humanitarian Engineering has the potential to contribute to solving many of the world's problems through sustainable human-centred solutions (Burnham, 2009; Campbell and Wilson, 2011). However, the aphorism and title of a book by Rambach (1730), that "the road to hell is paved with good intentions" is highly relevant to work in the humanitarian field, and thus to Humanitarian Engineering. Two of numerous examples of engineering solutions that started with good intent but failed and caused questionably more harm than good are the PlayPump (Borland, 2011; Walton, 2010) and the design of public restrooms in Kenya (Langat, 2019).

Although numerous codes of ethics or conduct and standards cover engineering practice (e.g. Engineers Australia, IEEE, IMechE, AS/NZ Standards and ISO) and humanitarian response (SPHERE Standard 2018), these typically do not address the specific overlap combining humanitarianism and engineering. Humanitarian Engineering is subject to neo-colonialism (Sagoe, 2011), voluntourism (Birzer and Hamilton, 2019), and generally unsuitable engineering (Arshad-Ayaz et al., 2020). It is therefore critical to explore the professionalisation of the Humanitarian Engineering field and the impact this may have on accountability and ethical practice.

In the Australian context, professionalisation of any engineering practice is likely to be under the auspices of Engineers Australia (EA). In light of the growth of Humanitarian Engineering, a Humanitarian Engineering Community of Practice (HECoP) was established in 2019 as part of the College of Leadership and Management within EA. Since then, roughly 800 members have joined the HECoP with the rapid expansion further justifying a timely investigation. The intent of HECoP is to "foster the application of professional engineering discipline to the leadership, management, design and delivery of humanitarian undertakings". It is therefore logical that explorations for professionalisation of Humanitarian Engineering are conducted with this community.

A challenge with professionalising *Humanitarian Engineering* is the various definitions and understandings of what is covered and meant by *humanitarian* context. Generally, these understandings cover one or more of 1) *humanitarian action* corresponding to events such as a sudden-onset disaster (e.g. earthquake, flood, cyclone); 2) *development assistance* through longer term response (e.g. capacity building, climate change mitigation); and 3) *peace building* (i.e. response to war, peace-making and peace-keeping). Some argue that there is a humanitarian-development spectrum while others that there is a humanitarian-development-peace nexus (Taylor 2016, Lie, 2020). The numerous humanitarian definitions flow through to understandings of Humanitarian Engineering and imply the field does not cover all three contexts mentioned. The Encyclopædia Britannica and Amadei et al. (2009) limit their definitions to development assistance, while others including Garrett (1999) and Reed (2002) limit Humanitarian Engineering to humanitarian action. Campbell and Wilson (2011) expand the definition such that Humanitarian Engineering relates to the broader humanitarian-development spectrum, while Cuny (1983) goes further to acknowledge Humanitarian Engineering also includes the peace building component. There are also definitions that simply reflect the notion of supporting disadvantaged, disempowered or underserved populations irrespective of the context (Muñoz and Skokan 2007; Lucena et al. 2010; Mitcham and Muñoz 2010; Mazzurco and Daniel, 2020). The various definitions result in difficulties in defining, and therefore professionalising, Humanitarian Engineering. However, despite the various definitions, the general understanding in Australia is that Humanitarian Engineering involves engineering practice to support and work with vulnerable communities and/or individuals, somewhere along the humanitarian-development spectrum. It is based on this general understanding that the authors and others from the HECoP have started to progress work towards a means of professionalising Humanitarian Engineering.

Purpose

Humanitarian engineers working in humanitarian action or development assistance tend to engage with communities and individuals who may experience vulnerability due to their context. Within these contexts inherent power imbalances exist and the engineer may make decisions that affect quality of life. An underlying assumption in this study is that these factors of power imbalance and

vulnerability create risk sufficient to warrant enhanced scrutiny of humanitarian engineers. The six-item agenda constructed by the HECoP (Brown and Smith, 2022), aims to "professionalise" Humanitarian Engineering by bringing the same level of rigour, review, and recognition to Humanitarian Engineering as for any field, area of practice or discipline of engineering. One item within the agenda required to achieve this is to develop a consensus on the *position* of Humanitarian Engineering in Australia relative to existing frameworks, which could be a discipline, specialisation, or area of practice, reflecting a specific body of knowledge, skills and techniques required to practice. The objective of this study is not to finalise the position of Humanitarian Engineering in Australia but to "get the ball rolling" and produce an agreed upon position amongst a sample of Humanitarian Engineering practitioners and other interested parties which can be added as an insight into the discourse. It is expected that this insight may stimulate further research in this topic. A finalised position will require the combination of insights from multiple studies and a broader consensus than what has been conducted to date.

Approach

To meet the objective of an agreed upon position amongst a sample of Humanitarian Engineering practitioners and for further insights an approach inspired by the Delphi method was selected (Linstone and Turoff, 1975). The Delphi method can be used to provide a group opinion or consensus on a particular topic by using multiple rounds of questionnaires and surveys with the group response summarised between rounds. Multiple rounds of collection, analysis, synthesis and refinement produce the overall finding. One addition was the use of a workshop as a research methodology (Ørngreen and Levinsen, 2017) rather than surveys alone. Participants were invited to attend a workshop in which rapid rounds of the refinement process were completed. The overall approach had multiple activities falling into three phases around the workshop:

Phase 1 - Interested participants were invited to complete an anonymous pre-survey based on previous research and work which generated an individual initial opinion on the position of Humanitarian Engineering in Australia. The research team then analysed the responses and generated a combined initial, or starting, position.

Phase 2 – The same participants were invited to a 2-hour workshop in June 2022 where the combined initial position was presented. In smaller breakout groups insights and critiques of the position were generated. Whilst breakout groups shared back insights with the whole group the research team synthesised the insights in real-time and generated an updated position. Participants returned to breakout groups and the process was repeated with the research team completing further synthesis. After the workshop the research team devised a final position as well as captured insights from discussions and note taking.

Phase 3 - The full participant list was sent the set of workshop insights with a second anonymous survey to gauge their level of agreement (using a 5-point Likert scale). The intention was that the final position would be circulated for approval, however, as discussed below this did not happen.

The Delphi method works well when a panel of experts are chosen as participants. Potential participants with the desired expertise were identified by members of the EA HECoP Steering Committee. Recruitment covered those with knowledge of Humanitarian Engineering practice or education, or with knowledge of engineering frameworks. Recruitment focussed on those with experience in the Australasian context. A limitation of recruitment is that all participants came from the contacts or people known to members of the HECoP Steering Committee. Thirty-six invitees registered to be involved in the study of which 13 completed the pre-workshop survey, 20 attended the workshop and 12 completed the post-workshop survey. Intentionally no tracking was completed to match responses across the three phases. Whilst the study was conducted through the HECoP, all activities were covered under an approved university human ethics protocol.

Results

Phase 1: Pre-workshop survey

The pre-workshop survey was distributed to everyone who registered their interest in the study, with 13 completions. These participants indicated their level of agreement to five statements using a five-point Likert scale with the results shown in ranked order in Table 1. An overrepresentation bias of respondents identifying themselves as working in tertiary education was seen (n=9), possibly due to the timing and duration of the workshop.

Table 1 Pre-Workshop survey results arranged in level of agreement (where SD=Strongly disagree, D=Disagree, N=Neither disagree or agree, A=Agree and SA= Strongly agree).

Statement	SD	D	N	A	SA	Agree Rate (%)
Humanitarian engineering experiences should count towards professional accreditation	0	0	0	3	10	100
Humanitarian engineering is an approach that can be applied to all engineering work	0	0	1	3	9	92
Humanitarian engineering education should be subject to external review	0	0	1	3	9	92
Humanitarian Engineering practice requires a high level of scrutiny	0	0	2	4	7	85
Humanitarian engineering is its own discipline, like electrical or civil engineering	0	2	2	7	2	69

Table 1 shows that the statement with the lowest agree rate (percentage of A+SA), related to Humanitarian Engineering being considered its own discipline; this statement was the only one to attract disagreement. The high support for 'experience being counted towards accreditation' and 'should be subject to external review' shows that a position was warranted and would need to be considered as part of existing engineering frameworks, for example EA Stage 2, Chartership. In addition to the Likert scale responses, participants were provided the opportunity to provide ideas for what they would like to see in the workshop along with other comments. Analysis of the survey and comments combined with experience of the research team led to the following initial position being formulated:

> The Initial Position
>
> *Humanitarian engineering is an approach that can be applied to all engineering work, rather than its own discipline. It involves a set of specific techniques and tools that are particularly appropriate to a range of development and humanitarian contexts, on both long- term and short- term timeframes.*
>
> *All engineers should have at least some Humanitarian Engineering competencies which should be appropriately accredited.*
>
> *Professional Engineers conducting humanitarian and development work should be able to demonstrate Humanitarian Engineering tools and techniques. This demonstration could be by being part of an area of practice. Humanitarian Engineering experiences should count towards professional accreditation, and Humanitarian Engineering education programs should be subject to external review.*

Participants were not shown the initial position before attending the workshop.

Phase 2 – Workshop

A Miro board (an online collaborative whiteboard) was used to guide the discussion. After some opening introductions and icebreakers, the initial position (mentioned above in italics) was presented before participants were then invited to review, discuss, and critique the initial position in small groups in four break-out rooms. After 20 minutes of group discussion, the participants returned to plenary to share their feedback.

There were a number of key insights and questions from the first breakout discussion. One point that came through strongly was that the emphasis should be on overarching principles and values, such as respectful community engagement, rather than an arguably more reductionist approach of conceiving of Humanitarian Engineering as a collection of tools and techniques.

Another point was about the need to define Humanitarian Engineering. An aspect raised was context – that is, is it the context that makes engineering humanitarian, or something else? Another aspect raised was around whether Humanitarian Engineering is its own specialisation, or an approach underlying all engineering, with one of the arguments made in response being that the contextual complexity, with legacies of colonisation and other power imbalances, demands it be its own area. A strategy that was suggested to explore these questions of definition is to ask "what's special about Humanitarian Engineering?" versus "what *isn't* Humanitarian Engineering?".

Other key points that were discussed included the multi-disciplinary nature of Humanitarian Engineering (with the observation that not all Humanitarian Engineering is 'engineering'); the inherent ambiguity of Humanitarian Engineering practice; how Humanitarian Engineering skills and experiences align with existing accreditation frameworks and conversely asking how might accreditation requirements impose hurdles to avoid harm from inexperienced practitioners while still offering pathways for novices to develop skills; and recognising the central role of engineers in enabling basic needs.

In real-time during this discussion, the research team partially updated the position statement to reflect some of these insights, adding the following text:

> *Humanitarian Engineering is guided by a set of principles and values, applied to a humanitarian context. It draws in elements from multi-disciplinary practice, especially from other professions.*

> *Engaging community is central to Humanitarian Engineering, and at its fundamental is about enabling basic needs.*

With this discussion and revised position in mind, participants returned to break-out rooms for further small-group discussions. The workshop closed with a final plenary discussion bringing together the feedback and key points raised.

Although the original intention had been to formulate a revised position statement for feedback within the workshop, this proved too ambitious and instead a number of questions and potential suggestions were collated which need to be explored and resolved before a position could be reached. These included questions around the importance and understanding of community and context; the extent to which EA Stage 1 and 2 competency frameworks cover the skills required in Humanitarian Engineering (and if and how these are operationalised in curricula and accreditation); and the need to focus on values and principles over tools and techniques. Other issues identified in the second round of discussion related to building pathways to competency through formal and informal training and experiences, and what role, for example, hackathons play (or don't play) in such a pathway; how to define Humanitarian Engineering in terms of how and when it is practiced or applied, what it involves, and why we do it; and who can speak for Humanitarian Engineering – Engineers Australia, the Humanitarian Engineering Community of Practice, or others.

To more clearly synthesise and condense the workshop outcomes, the research team met several times in the two weeks following the workshop. Each author independently wrote up a one-page summary of their insights from the workshop, which were then combined and used in discussion to reach consensus about key points and questions. These key points and questions were then

further distilled into survey items, to be sent out to workshop registrants for validation and further feedback. This comprised several "insight statements" where respondents could indicate their agreement on a Likert-scale, as well as a number of suggested values and principles for respondents to rate their relevance to Humanitarian Engineering. The survey also included an open text field for any other comments and a prompt for other values or principles.

Phase 3 – Post workshop survey

The post-workshop survey invitation was emailed to all 36 people who had registered their interest in the work, regardless of if they attended the workshop or not. The survey was open for two-weeks. There were 12 valid responses (8 of whom indicated they had attended the workshop), corresponding to an overall response rate of 33%. As discussed above the finalised position was not circulated for approval as part of the post-workshop survey. Agreement with the insights derived from the workshop are provided in ranked order in Table 2.

Table 2 Ranked agreement with insight statements from the workshop (where SD=Strongly disagree, D=Disagree, N=Neither disagree or agree, A=Agree and SA= Strongly agree).

Insight Statement	SD	D	N	A	SA	Agree Rate (%)
Humanitarian Engineering education and practice in Australia should be subject to review and accountability	0	0	1	6	5	92
Specialised expertise is required before undertaking engineering practice in most humanitarian or development contexts	0	1	1	4	6	83
An agreed definition of Humanitarian Engineering is required before determining its position with the engineering profession in Australia	0	1	1	6	4	83
A better understanding of Humanitarian Engineering is required before its position with the engineering profession in Australia can be determined	0	1	3	7	1	67
In Australia Humanitarian Engineering is not a specific discipline of engineering (like electrical or civil)	0	1	3	6	1	58
Values and principles are more important for Humanitarian Engineering practice than specific tools and techniques	0	2	3	3	4	58
Practice for Humanitarian Engineering is already appropriately defined through Engineers Australia Stage 1 (graduate) and 2 (chartered) competency standards	0	1	6	4	0	33

The results in Table 2 indicate that there needs to be accountability for Humanitarian Engineering and this is probably not sufficiently captured in the existing EA competency standards. There was agreement that specialised expertise was required to practice but no clear agreement that it was more important to consider values and principles than specific tools and techniques. There was agreement that more work needed to be done before generating a position on Humanitarian Engineering, a gap between the 'definition' statement and the 'understanding' statement suggests some people believe there is enough understanding to move forward with a definition but that a definition is required. In addition to the insight statements a set of values and principles that emerged from the workshop were presented to the respondents. The results for the level of relevance of each is shown in Table 3.

Table 3 Ranked relevance for values and principles identified in the workshop.

Value/Principle	Not	Some-times	Highly	Essential	Highly or Essential Rate (%)
Promoting human welfare and dignity	0	0	1	11	100
Ethical practice	0	0	2	10	100
Preventing harm	0	0	2	10	100
Accountability	0	0	4	8	100
Respectful community engagement	0	0	4	8	100
Empathy	0	1	3	8	92
Reflexivity	0	1	5	6	92
Social Justice	0	2	2	8	83

Table 3 indicates broad relevance for most of the principles presented with 'promoting human welfare and dignity' achieving almost consensus on being an essential value. An open text box for respondents to enter additional values and principles saw the following being added: *diversity, equity* and *inclusion*, *humanity, neutrality, impartiality,* and *independence*, while *preventing harm* was suggested to expand to *do no global harm*.

Discussion

The research purpose for this work was partly met, the process did "get the ball rolling" on the position of Humanitarian Engineering in Australia but an agreed upon position amongst a sample of Humanitarian Engineering educators and practitioners was not found. It is suggested that the underlying assumption that there was enough agreed understanding of Humanitarian Engineering and that a stronger definition was not required was incorrect. This also reflects the fact that much of the existing literature and therefore potentially understanding is dated or not entirely suited to the Australian context. Another likely reason the final position was not suitable is that the initial position was not targeted enough to establishing a position within existing frameworks, therefore the discussion in the workshop and debate on the position related more to factors surrounding the position and the necessity for a position rather than determining the position itself. An initial position that stated that Humanitarian Engineering should be considered an area of practice within EA may have driven the discussion in a different direction.

Whist a consensus position was not reached several important insights were gathered which provide considerations for a position on Humanitarian Engineering in Australia. Combining insights from the workshop with findings from the pre- and post-surveys would seem to suggest:

1. Humanitarian Engineering should not be a specific discipline (69% and 58% agreement to being a discipline in the pre- and post-surveys respectively and noting the drop after the workshop). This corresponds with the perspective of van der Steen (2008) that Humanitarian Engineering is not a discipline, and "must transcend all engineering disciplines".

2. Strong agreement that Humanitarian Engineering education and practice should be subject to external review and accountability. This is highlighted in both surveys (more than 80% for the three related questions across the two surveys). It remains to be determined if existing methods and framework (such as those within EA and/or from the humanitarian sector) are enough and appropriate. Related to this was the strong agreement that Humanitarian Engineering should be available to contribute to professional engineering recognition within EA. Interestingly, almost 40% of respondents to the pre-workshop survey (n=5) were not

members of EA. This suggests that either accountability needs to be seen across disciplines, or maybe that humanitarian engineers don't feel like they belong at EA.

3. There is a view that Humanitarian Engineering can contribute positively to all engineering work, but to practice specifically requires specialist expertise, although this can vary significantly depending on context and role. There is still discussion on why all engineering is or is not Humanitarian Engineering.

4. Humanitarian Engineering is underpinned by values and principles although results suggest they are not necessarily that much more important than the tools and techniques used. Considered highly relevant or essential were the values and principles of *respectful community engagement*, *ethical practice*, *preventing harm*, *accountability*, and *promoting human welfare and dignity*. While some of these are mentioned in EA Stage 1 or 2 competencies and the EA Code of Ethics, the discussion and post-survey would seem to indicate these do not sufficiently capture what is required for Humanitarian Engineering practice.

5. There needs to be further discussion and agreement on an understanding of the specific or specialist contexts where Humanitarian Engineering can be practiced and/or a specific definition. This echoes existing literature, academics at Coventry University finding that "the only thing that is clear is that there is no clear definition" (Hill and Miles 2012).

In developing these findings, the following limitations were identified:

- The selective nature of the initial invitations to engage with the process outlined here, although this was always viewed as a starting point, not the only engagements to take place.
- The small sample size and the skew towards those in the university sector. An appropriate engagement strategy for further work needs to ensure access and inclusion from broader stakeholder groups.

Conclusions

Through a modified Delphi approach, findings and insights on the potential position of Humanitarian Engineering in Australia were discussed and drawn from an initial group of those with expertise in the field. Whilst this did not, as planned, develop text for a position, it did reinforce some assumptions and provide a set of next steps for professionalising Humanitarian Engineering in Australia. The need for external review and accountability was clear, while the view that Humanitarian Engineering is a separate discipline was not, suggesting that it is a form or specialisation or area of practice. Further discussion is required on the specialist contexts for Humanitarian Engineering and what makes these different from any engineering practice. Assumptions on the link between professionalism and competency also need to be explored. Following from these, some next steps for this ongoing work are:

- Determine if professionalism is the only mechanism to ensure accountability and ethical practice and check the assumption that professionalism actually leads to accountability and ethical practice.
- Evaluation of existing elements of EA competency frameworks at all levels for their relevance for Humanitarian Engineering (as generally understood in Australia).
- Assessment of the opportunities for review of Humanitarian Engineering within existing frameworks, from EA and the humanitarian response and development assistance sectors.
- Engagement and input from a wider variety of stakeholders, to learn from similar discussions in other sectors (such as humanitarian response) and overseas.
- Development of a discussion paper on the definition and position of Humanitarian Engineering by the HECoP to distribute within EA shaped by the findings here and previous work. This follows other examples within EA including Rehabilitation Engineering in Australia.

Regardless of terms, names and definitions, these suggestions, along with other ongoing work in this area, capture the essential need for continuous discussion, engagement and critique of not only Humanitarian Engineering but engineering, from within and beyond the profession, and their roles in supporting quality of life and human well-being for all.

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