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Community Engagement with Engineering: Establishing Principles

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Abstract (150 – 200 words)

Community engagement with engineering is essential to deliver the Sustainable Development Goals and to address wicked problems such as climate change. This paper presents a statement of Principles for Community Engagement with Engineering, to underpin best practice across the infrastructure project lifecycle. The principles are:

1. Supporting sustainable, thriving communities is a core purpose of the engineering profession.
2. Community impacts and interests are integral to engineering design and delivery.
3. Community engagement should begin at the conception of projects, and continue throughout the engineering and infrastructure lifecycle.
4. A tailored engagement approach with clear objectives, processes and expectations should be agreed among all stakeholders, including community leaders and representatives, at the outset of infrastructure decision-making and planning.
5. Engineering and infrastructure projects should identify the diverse needs and aspirations of communities they work with and for, giving special attention to include groups that are typically marginalised.
6. Community engagement should consider how individuals and groups of different race, age, faith, disability, gender, sexuality, family circumstances, economic status, and other characteristics and may be differently impacted by infrastructure development, and may welcome different forms of engagement.
7. Methods of engagement should recognise power inequalities, and enable two-way communication and learning between communities and engineering and infrastructure projects.
8. Information about engineering and infrastructure projects and their impacts should be shared with community members as part of a two-way process, with information being accessible to all people.

Keywords chosen from ICE Publishing list

Codes of practice and standards; Infrastructure planning; Sustainable development.

1 **Introduction**

2 Enabling sustainable and resilient communities is a core purpose of civil engineering. The
3 Institution of Civil Engineers (ICE) Code of Conduct states ‘All members shall have full regard
4 for the public interest, particularly in relation to matters of health and safety, and in relation to
5 the well-being of future generations’. Community engagement can help to maximise and share
6 benefits, minimise and mitigate negative impacts of projects on communities, and improve
7 project delivery and outcomes (Figure 1). Effectively engaging with local communities is a
8 responsibility of engineers at different stages of the infrastructure lifecycle, from conception to
9 decommissioning, and at different organisational levels and career stages, from apprentice and
10 graduate to senior leader and policy maker.

11
12 This paper presents a statement of Principles for Community Engagement with Engineering. It
13 begins with review of literature related to community engagement, and its value to engineering
14 projects, with emphasis on infrastructure projects. The paper describes the process of
15 developing the principles, including a first draft based on literature and other examples, which
16 was presented at an ICE Strategy Session to seek feedback from interested members and
17 stakeholders, and then the final principles which were presented to the ICE in 2021.

18
19 Community engagement takes many forms, depending on the site, project and community.
20 Whilst it is important to document and share best practice in community engagement with
21 infrastructure, due to the uniqueness of each project and its context, the identification and
22 definition of the relevant “community” and the methods employed will be vast, varied and
23 constantly evolving. The principles provide core guidance to the purpose, value and nature of
24 good community engagement, providing a foundation across sectors, regions and scales of
25 project. They also set out a challenge to the sector to reflect on how project delivery
26 mechanisms and processes can give earlier and greater consideration to local expertise and
27 needs, and work with communities as necessary partners in delivering sustainable and resilient
28 infrastructure. The principles offer insight into how the core knowledge and skillset of civil
29 engineers and other built environment professionals needs to adapt to meet this challenge.

30

31 **2. Community engagement with engineering**

32 Community engagement is an essential element of efforts by the engineering profession to work
33 more closely with stakeholders and to deliver the United Nations Sustainable Development
34 Goals (SDGs). The UK Engineering Council (2013) defined principles for professional engineers
35 including to 'engage with stakeholders, listening and recognising the value of the perspectives
36 of others, including non-specialists'. The mission of the Institution of Civil Engineers (ICE)
37 Sustainability Route Map (ICE, 2020) is to 'Make the UN Sustainable Development Goals
38 accessible to built environment professionals'. The SDGs require global, multi-stakeholder
39 engagement to mobilise resources, and local engagement to deliver outcomes. Allied to this
40 vision is the objective of 'Embedding the delivery of Sustainable Development Goals into
41 everyday engineering practice'.

42

43 Engineers have historically solved problems by designing and constructing functional
44 infrastructure, and are often perceived as relatively dissociated from collective goals such as
45 working with communities and stakeholders (Hoh, 2009; Natarajathinam et al. 2021). As
46 evidenced by the SDGs and the recent responses of industry bodies (Engineering Council,
47 2015; ICE, 2020) the profession is now facing challenges that cannot be solved by conventional
48 technical projects. So called 'wicked problems' cannot be solved by a single response, but can
49 only be made better or worse from different standpoints (Seager et al., 2012). There has been a
50 growing emphasis on taking a systems perspective to characterise the environmental and social
51 aspects of sustainability, and this requires a greater ability to engage with communities to
52 understand the problem from the perspective of all stakeholders. Taking a holistic perspective
53 that respects and draws in community information to understand how social factors intersect
54 with technical and environmental systems is essential for tackling wicked problems such as
55 climate change (IEA, 2021).

56

57 Construction sites that were once considered to be islands of economic activity may become
58 catalysts for change to deliver better environmental and social outcomes. This new mindset
59 comes with its own challenges. For example, economic activity from infrastructure projects is
60 relatively easy to define in terms of cost and time. On the other hand, environmental and social

61 value are more difficult to assess and measure using conventional methods, and generally
62 involve a longer time scale than construction projects. Moreover, the legacy of primarily techno-
63 centric engineering education has meant that typically civil engineers are not trained in the
64 terminology of the frameworks used to assess social and environmental value
65 (Natarajathinam et al., 2021). As engineers widen their remit to include environmental and
66 social value, the extent of success and failure becomes wider than the project boundaries.
67 Engineering teams increasingly deal with wicked problems which by their nature can never be
68 solved entirely, but can be improved with constructive collaboration across sectors, disciplines
69 and stakeholders. Community engagement is a central element of this new way of working, as
70 are the requirements for the sector to review competencies and continuing professional
71 development to equip engineers to competently undertake this work (ICE, 2021).

72

73 Beyond statutory and regulatory obligations, the specifics of environmental and social value are
74 likely to be different for each project depending on what local communities value. This variability
75 is why an understanding of needs is recommended by Dobson (2020) and the UK Green
76 Building Council (2020). Community engagement can provide individuals and communities with
77 opportunities to participate in processes whereby local and global values are explored. This
78 could enable communities to consider and make adaptations to their own actions, particularly in
79 reducing climate impacts, thereby contributing to the achievement of net-zero carbon. Engineers
80 can control the embodied and operational carbon but only influence user carbon (Chapman,
81 2020). Engagement and influence support significant end user changes. The successful
82 influencing of end users may largely determine whether social and environmental goals are met.
83 In the context of the UK's Carbon Net Zero Commitment even strict control on embodied and
84 operational carbon may not be sufficient without 'buy in' from the end user (HM Government,
85 2021).

86

87 **3. Community engagement and participation**

88 Community engagement is an umbrella term that covers multiple approaches and methods. It
89 differs from public participation in extending beyond decision-making to implementation and
90 operation, and is an ongoing process. In developing Principles for Community Engagement with

91 Engineering, community engagement is conceived to include participation, communication,
92 consultation and collaboration between communities and infrastructure clients and contractors,
93 across the infrastructure lifecycle. In recent years, the benefits of effective engagement at
94 reducing conflicts and allowing communities to influence the future shape of the places they live
95 have been increasingly recognised. Addressing the causes and impacts of the climate crisis and
96 other wicked problems requires fundamental changes in the way society and infrastructure
97 function, including embedding critical and well-thought-out practices of community engagement
98 into projects as standard (Sharp, 2017; Ward et al., In review).

99

100 There are different levels of engagement that relate to the degree of control and influence the
101 community has on the project. Arnstein's (1969) 'ladder of participation' is an oft-cited example,
102 where increasing degree of citizen control moves the project higher up the ladder. However, the
103 ladder model has been critiqued for lacking nuance and suggesting that projects should be
104 considered failures if they do not achieve full citizen control (Rollason et al., 2018).

105

106 More recent conceptualisations of engagement seek to explore the complex and non-linear
107 interactions which occur during projects, for example Wilcox (1994), Plummer and Fitzgibbon
108 (2004), or Mahmoud et al. (2021). Other approaches focus on identifying and addressing
109 common problems and issues, such as 'HEADS UP' (i.e. hegemony, ethnocentrism,
110 ahistoricism, depoliticisation, uncomplicated solutions, and paternalism). HEADS UP is based
111 on the principle that to work towards ideals of justice requires better understanding of the social
112 and historical forces that connect citizens (Andreotti, 2012). A step further, and complementary
113 to but distinct from public or community engagement, is co-creation, which focuses on the co-
114 design and co-production processes that enable a product, service or infrastructure to be
115 designed and delivered in collaboration with a community, customised, or even personalised, to
116 embed their needs, drivers or preferences alongside those of the overarching project (De Konig
117 et al., 2016).

118

119 Answering the critique of Arnstein's ladder, it is important to recognise that there is no optimum
120 model for engagement in any given project, and that each engagement level may be evident in

121 different projects and contexts, depending on external conditions, organisational and political
 122 culture, cost, and resources. Although greater citizen involvement in decision-making implies
 123 stronger engagement; this may not always be possible or desirable due to planning, regulatory
 124 or budgetary constraints which operate at scales larger than individual projects or host
 125 communities (Rollason et al., 2018). While community engagement is suggested to potentially
 126 move beyond traditional top-down approaches, some scepticism has been offered regarding the
 127 degree to which the citizenry and community groups can influence projects (Head, 2007).
 128 Alongside this, community engagement is not a linear process. To avoid misunderstandings
 129 over the role that host communities will have in any project, it is important to identify and agree
 130 on the purpose and limitations of engagement activities with the community, both to provide
 131 transparency and allow the community control. In this way 'community engagement' is not a
 132 product or delivery which a project might produce, but a process (Reed, 2008; Chow and
 133 Leiringer, 2020), which has likely been running prior to any project beginning and will continue
 134 to run after project completion.

135
 136 The typology presented by Wilcox (1994) divides engagement activities in to participatory and
 137 non-participatory types (Table 1). What differentiates these is the power relationship between
 138 different stakeholders: consultation and information-giving are one-way relationships, either
 139 distributive or extractive; in contrast deciding- and acting-together and supporting involve the
 140 dispersion of power often to traditionally disempowered stakeholders.

141

142 Table 1. Different levels of community engagement. Adapted from Wilcox (1994)

| Level of Engagement | Description |
|-------------------------------------|---|
| Non-participatory Engagement | |
| Information | Telling people what is planned or sharing knowledge, for example, through leaflets or factsheets. |
| Consultation | Offering some options, listening to feedback but not allowing new ideas, for example, through surveys or interviews |
| Participatory Engagement | |
| Deciding Together | Encouraging additional ideas or options; deciding jointly on the plans, for example, through focus groups. |

| | |
|-----------------|---|
| Acting Together | Different interests decide on what is done and form a partnership to carry it out, for example, through citizen forums. |
| Supporting | Local groups or organisations are offered funds, advice or other support to develop their own agendas within guidelines, for example, through seed funding. |

143

144

145 Stakeholder and citizen engagement is widely promoted to ensure sustainable management of
 146 the environment and natural resources. Reed (2008) reviews the literature relating stakeholder
 147 engagement in environmental management, including its benefits. The review identifies eight
 148 features of best practices in stakeholder participation:

- 149 1. Stakeholder participation needs to be underpinned by a philosophy that
 150 emphasises empowerment, equity, trust and learning
- 151 2. Where relevant, stakeholder participation should be considered as early as
 152 possible and throughout the process
- 153 3. Relevant stakeholders need to be analysed and represented systematically
- 154 4. Clear objectives for the participatory process need to be agreed among
 155 stakeholders at the outset
- 156 5. Methods should be selected and tailored to the decision-making context,
 157 considering the objectives, type of participants and appropriate level of
 158 engagement
- 159 6. Highly skilled facilitation is essential
- 160 7. Local and scientific knowledges should be integrated
- 161 8. Participation needs to be institutionalised

162

163 Community engagement is emerging as an issue of concern across the infrastructure sector,
 164 and as such, there is a growing body of guidance relating to it. The English Environment
 165 Agency's 'Working With Others' presents engagement as a step-by-step process to help deliver
 166 flood alleviation schemes that are acceptable to communities. However, the relative lack of
 167 community decision-making mechanisms and a 'one size fits all' approach have been criticised

168 (Mehring et al., 2018). The CIRIA Guide C751 "Communication and engagement in local flood
169 risk management" outlines a range of techniques for engaging communities and provides
170 guidance on selection for particular contexts (Daly et al., 2015). Various community planning
171 toolkits are also available, providing guidance on the issues to consider when planning and
172 designing community engagement (Community Places, 2012).

173

174 Despite the development of best practice guidance and increasing awareness of the need for
175 community engagement with projects, many projects proceed without meaningful engagement,
176 or with limited or flawed engagement (Cilliers and Timmermans, 2014). The reasons for a lack
177 of meaningful engagement with projects include high-level constraints on programmes and
178 budgets (Rollason et al., 2018); a lack of education and training for engineers in community
179 engagement (Harsh et al. 2016-); deeply embedded top-down practices (Mehring et al., 2018);
180 and a lack of understanding of the potential contribution that communities can provide (Lane et
181 al., 2018). For example, during preparation for the London Olympics despite initiatives such as a
182 public competition to select suitable names for neighbourhoods surrounding the Queen
183 Elizabeth Olympic Park, there were limited wider public participation exercises that failed to
184 engage with the 'experience and feeling' of places, which would have helped to influence and
185 enhance community dynamics (Gold and Gold, 2020). This led to a local legacy of small
186 business failure fuelled by rising rents and homogenisation of the local area, diluting place-
187 based cultural offerings (Duignan, 2019).

188

189 **4. Drafting the ICE Principles**

190 In 2019 the ICE established a Community of Practice (CoP) on Community Engagement. The
191 purpose of the CoP is to develop and share best practice in community engagement for ICE
192 members, other researchers and practitioners, and people with live, local experience as
193 community members. The CoP identified the need for a set of principles relating to community
194 engagement with infrastructure, to guide best practice and policy intervention. The CoP wrote
195 the first draft of the ICE Principles for Community Engagement with Engineering based on
196 Reed's (2008) features of best practice.

197

198 An ICE Strategy Session webinar on 'The value of community engagement on infrastructure
199 projects' on 10 November 2020 presented the draft Principles (ICE, 2020). The event was
200 promoted through ICE communications, including social media, and was shared with networks
201 associated with the CoP members. The webinar was held in the morning UK time, to allow
202 international audience members to join from Asia and the Middle East. The webinar consisted of
203 a panel discussion involving CoP members Anusha Shah, Monika Szczyrba, Peter Trimmingham
204 and Sarah Bell, who presented the draft Principles. Participants in the Strategy Session were
205 asked to provide feedback on the Principles in a short survey at the end of the event. Individuals
206 and groups also provided more detailed feedback by email to CoP after the event. The
207 comments were coded using inductive qualitative analysis to identify key themes and to identify
208 for suggestions for changes to the principles. The final principles were written to reflect the
209 feedback from the participants and respondents, and further discussion and reflection within the
210 CoP. This section presents the draft principles, the Strategy Session survey results, summary
211 of the themes emerging in the responses, and the final statement of principles.

212

213 The draft Principles for Community Engagement with Engineering were:

- 214 1. Supporting sustainable, healthy communities is a core duty of every engineer.
- 215 2. Technical decisions are social decisions. Community impacts and interests are
216 part of, not separate to, engineering design and delivery.
- 217 3. Community engagement should be considered as early as possible and
218 throughout the engineering and infrastructure lifecycle.
- 219 4. Communities are diverse. Engineering and infrastructure projects need to
220 identify needs and aspirations of communities they work with and for. This
221 includes addressing how race, faith, disability, gender, family circumstances
222 and economic status lead to different opportunities to engage and impacts for
223 different groups.
- 224 5. Community engagement with engineering and infrastructure projects should be
225 based on empowerment, equity, trust and knowledge exchange.
- 226 6. Communities should be provided with appropriate information about
227 engineering and infrastructure projects and their impacts.

- 228 7. Relevant community groups and stakeholders in engineering decisions and
229 projects need to be identified and represented systematically.
- 230 8. Clear objectives for processes of engagement need to be agreed among
231 participants at the outset.
- 232 9. Methods of engagement should recognise and account for power inequalities to
233 enable two-way learning between participants.
- 234 10. Methods should be selected and tailored to the decision-making context,
235 considering the objectives, type of participants and appropriate level of
236 engagement.

237

238 More than 900 people attended 'The value of community engagement on infrastructure projects'
239 webinar which presented the draft principles, and 143 responded to relevant questions in the
240 feedback survey. The survey included open questions to provide suggestions for changes. The
241 survey asked participants to identify their role in the topic of the webinar. Figure 2 shows that
242 73% identified as engineers, 13% as engagement professionals, 8% as community members
243 and 12% as 'other'. The draft principles were also published on The Civil Engineer blog
244 promoting the Strategy Session ([https://www.ice.org.uk/news-and-insight/the-civil-
245 engineer/november-2020/engaging-communities-a-role-for-engineers](https://www.ice.org.uk/news-and-insight/the-civil-engineer/november-2020/engaging-communities-a-role-for-engineers)) and seeking email
246 feedback. 19 people, including representatives of community-based organisations, responded
247 by email to the draft principles, including suggestions for changes.

248

249 In response to the question 'Is a statement of Principles of Community Engagement with
250 Engineering needed?', 98% replied 'yes'. The related comments addressed the drivers for a
251 statement of Principles, and further information and suggestions related to the draft statement.
252 Table 2 shows that the highest number of comments related to slow progress of community
253 engagement practice in engineering and infrastructure as a justification for the need for a
254 statement of principles from the ICE. The next highest number of comments related to the cost
255 of engagement, the sheer difficulty of achieving good engagement, and suggestions to
256 incorporate the community engagement and the principles into the ICE Code of Conduct and
257 professional development of engineers.

258

259 Table 2: Themes in comments responding to the question 'Is a statement of Principles of
260 Community Engagement with Engineering needed?'

| Theme | Count |
|--------------------------|-------|
| Slow progress | 6 |
| Cost | 4 |
| Difficulty | 4 |
| Professional development | 4 |
| Code of Conduct | 4 |
| Importance | 3 |
| Sustainable development | 3 |
| Definition | 2 |
| Diversity | 2 |
| Existing standards | 2 |
| Client | 1 |
| Trust | 1 |
| Collaboration | 1 |
| Communication | 1 |
| Consistent standards | 1 |
| Democracy | 1 |
| Education | 1 |
| Project lifecycle | 1 |
| Vocal minority | 1 |

261

262 Survey respondents were asked to rate the importance of each of the draft principles on a 5-
263 point scale from 'not at all important' to 'very important'. Figure 3 shows that the principles were
264 all rated 'very important' or 'somewhat important' by most of respondents. Table 3 presents the
265 relative ranking of the principles based on a weighted average of the responses. Principle 3
266 'Community engagement should be considered as early as possible and throughout
267 the engineering and infrastructure lifecycle', received the highest importance rating. Principle 2
268 'Technical decisions are social decisions. Community impacts and interests are part of, not
269 separate to, engineering design and delivery' and Principle 5 'Community engagement with
270 engineering and infrastructure projects should be based on empowerment, equity, trust and
271 learning' were ranked as the least important.

272

273 Table 3: Relative ranking of importance of the draft principles

| Draft Principles | Relative Importance Ranking |
|--|------------------------------------|
| 1. Supporting sustainable, healthy communities is a core duty of every engineer. | 2 |
| 2. Technical decisions are social decisions. Community impacts and interests are part of, not separate to, engineering design and delivery. | 9 |
| 3. Community engagement should be considered as early as possible and throughout the engineering and infrastructure lifecycle. | 1 |
| 4. Communities are diverse. Engineering and infrastructure projects need to identify needs and aspirations of communities they work with and for. This includes addressing how race, faith, disability, gender, family circumstances and economic status lead to different opportunities to engage and impacts for different groups. | 5 |
| 5. Community engagement with engineering and infrastructure projects should be based on empowerment, equity, trust and learning | 9 |
| 6. Communities should be provided with appropriate information about engineering and infrastructure projects and their impacts | 3 |
| 7. Relevant community groups and stakeholders in engineering decisions and projects need to be identified and represented systematically | 6 |
| 8. Clear objectives for processes of engagement need to be agreed among participants at the outset | 4 |
| 9. Methods of engagement should recognise power inequalities and enable two-way learning between participants | 8 |
| 10. Methods should be selected and tailored to the decision-making context, considering the objectives, type of participants and appropriate level of engagement | 7 |

274

275 The comments raised in response to the question of the importance of each principle covered a
276 range of issues: the relationship between community engagement and democratic decision
277 making and representation; associated costs, issues related to the specific expression and
278 definition of the principles; diversity; and managing the impact of a vocal minority of community
279 members in engagement processes. Table 4 summaries the key themes raised in the
280 comments.

281

282 Table 4: Themes in comments responding to the question ‘How do you rate the importance of
283 each of the Draft Principles of Community Engagement with Engineering?’

| Theme | Count |
|--------------------------|--------------|
| Democracy | 8 |
| Cost | 6 |
| Expression | 6 |
| Professional development | 6 |
| Diversity | 5 |
| Implementation | 5 |
| Vocal minority | 5 |
| Definitions | 4 |
| Project lifecycle | 4 |
| Clients | 3 |

| | |
|-------------------------|---|
| Conflict | 3 |
| Transparency | 3 |
| Learning | 3 |
| Sustainable Development | 2 |
| Place | 1 |
| Resilience | 1 |

284

285 The survey and email responses to the webinar and blog post indicated strong support for an
 286 ICE statement of principles. Each principle was revised based on specific criticisms and
 287 suggestions provided during the feedback process. Overall comments relating to repetition,
 288 brevity and clarity of language also informed the final version. The final principles are:

289

| Principles for Community Engagement with Engineering | |
|---|--|
| 290 | 1. Supporting sustainable, thriving communities is a core purpose of the engineering |
| 291 | profession. |
| 292 | 2. Community impacts and interests are integral to engineering design and delivery. |
| 293 | 3. Community engagement should begin at the conception of projects, and continue |
| 294 | throughout the engineering and infrastructure lifecycle. |
| 295 | 4. A tailored engagement approach with clear objectives, processes and expectations |
| 296 | should be agreed among all stakeholders, including community leaders and |
| 297 | representatives, at the outset of infrastructure decision-making and planning. |
| 298 | 5. Engineering and infrastructure projects should identify the diverse needs and |
| 299 | aspirations of communities they work with and for, giving special attention to include |
| 300 | groups that are typically marginalised. |
| 301 | 6. Community engagement should consider how individuals and groups of different race, |
| 302 | age, faith, disability, gender, sexuality, family circumstances, economic status, and |
| 303 | other characteristics and may be differently impacted by infrastructure development, |
| 304 | and may welcome different forms of engagement. |
| 305 | 7. Methods of engagement should recognise power inequalities, and enable two-way |
| 306 | communication and learning between communities and engineering and infrastructure |
| 307 | projects. |
| 308 | 8. Information about engineering and infrastructure projects and their impacts should be |
| 309 | shared with community members as part of a two-way process, with information being |
| 310 | accessible to all people. |

311

312 **5. Discussion**

313 The large number of responses and engagement in the consultation process gives confidence
 314 that the results are robust and there is strong support for the principles (93% of 143
 315 respondents). The data indicate that there is wide recognition of the benefits of engaging with
 316 communities early and that engineers see their core role as supporting sustainable, healthy
 317 communities (Table 3). The support for the principles is represented in Table 2 and stems from
 318 the 'slow progress' seen to date, the 'cost' and the need for 'professional development' to

319 engage with the 'difficulty' of community engagement. Adopting the principles would give more
320 explicit direction for those seeking to uphold the ICE's code of conduct in practice.

321

322 It should be noted that the context in which the data has been gathered has a bearing on the
323 support and ranking of principles. Participants were self-selecting, likely with a pre-existing
324 interest in community engagement, and largely drawn from the ICE community of professional
325 engineers (73%) rather than engagement professions (13%) or communities (8%). As these
326 principles are adopted and used, it is worth reflecting on how these principles are seen and
327 interpreted by these different groups, and how impactful community engagement is framed from
328 their viewpoints. For instance, it is notable that the draft principles of 'methods of engagement
329 should recognise power inequalities and enable two-way learning between participants' and
330 'community engagement with engineering and infrastructure projects should be based on
331 empowerment, equity, trust and learning' were ranked 8th and 9th by participants. Effective
332 community engagement that utilises 'deciding-together' and 'acting-together' strategies (Wilcox,
333 1994) of co-creation, and avoids 'one-size fits all' approaches necessarily cedes more control
334 over deciding what matters in a project to the community. The results of the survey show that
335 this is least supported, even amongst a cohort of participants who expressly support community
336 engagement, suggesting reticence by engineers to cede decision-making and expertise to
337 communities. Draft principle 2, 'Technical decisions are social decisions. Community impacts
338 and interests are part of, not separate to, engineering design and delivery' was also ranked 9th
339 by participants, and was not included in the final list. The ranking and associated comments
340 indicate that participants largely conformed to a conventional understanding of engineering as a
341 technical profession, in contrast to critical social science reframing of engineering and
342 infrastructure as socio-technical (Bell, 2011). Dialogue and reflection is needed to find a balance
343 that respects and recognises the technical expertise of engineers, alongside the local expertise
344 of communities, and the expertise of those professionals trained to be a bridge between them. If
345 this can be done in a way that reframes community engagement as beneficial to projects and
346 thus engineers, then it is more likely that empowerment of communities will be understood in a
347 more positive light.

348

349 **6. From principles to action**

350 Sustainable development challenges engineers to deliver projects in the context of wicked
351 problems, requiring greater attention to systemic interactions between economic, environmental,
352 and social aspects. Community engagement is an important way to incorporate social aspects
353 into design proposals and throughout the infrastructure lifecycle. It is also important for
354 engineers to involve clients and users early in the process. There is a common misconception
355 amongst client and engineers that engaging with stakeholders for design development is a great
356 undertaking which strains a project's budget and timeline. This will often discourage many from
357 incorporating community engagement into infrastructure and projects. Here, it becomes
358 important for engineers and designers to actively engage with users from the very start. Working
359 with clients to build a program for engagement helps to create a better understanding of
360 community engagement and how best to incorporate it into design and delivery. This way
361 stakeholders become an integral part of design and operation, rather than an expensive
362 afterthought.

363

364 Depending on the nature of the project, community and stakeholder engagement throughout the
365 lifetime of the project may be essential to prevent project failure. Beyond future cost
366 implications, initial funding in recent years has also started to be influenced by stakeholder
367 engagement. Now briefs for many funding schemes in England such as Low Emission
368 Neighbourhoods and the Good Growth Fund, Towns Fund require community involvement in
369 the design phases to be granted funding.

370

371 The ICE Principles for Community Engagement with Engineering are adaptable guidelines for
372 best practice when engaging with local communities as stakeholders. They are a starting point
373 to build specific engagement strategies for infrastructure and design projects of any scale.

374 These flexible guidelines are intended to encourage engineers to work with clients, investors,
375 and allied professionals to develop their own action plans which will meet their specific needs.

376 For some projects, maximum input and effectiveness from community engagement will be at
377 concept design phases, and for some it will be at detail design or even operational stages which
378 means not all projects need the same level of community input at the same time. However,

379 Principle 3 indicates that community engagement should always begin at conception, and
380 implies a clear strategy should be developed and planned at that stage. The methods of
381 engagement can vary, depending on projects, but the core values of all engagement processes
382 are consistent through the adoption of the principles.

383

384 Implementation of the principles requires collaboration between engineers and other built
385 environment professions, as well as with communities. Engineers themselves may not
386 undertake all aspects of community engagement work, which may require specialist
387 professional skills and lived experience. As leading actors in infrastructure conception and
388 delivery, engineers are well placed to ensure that the principles are incorporated into
389 infrastructure projects, drawing on diverse skills and professions as required.

390

391 Conventional education and professional development of civil engineers has not historically
392 emphasised the benefits of and responsibility for community engagement. Respondents to the
393 survey about the principles highlighted the need for continuing professional development
394 activities in this field. This also presents a challenge for reform of undergraduate engineering
395 education. Inclusive community engagement requires appreciation of diverse viewpoints,
396 understanding of power dynamics, a tolerance of complexity, conflicting information and
397 ambiguity. These are all characteristics of wicked problems, but are not typically included in
398 mainstream civil engineering training and education.

399

400 Improving 'interactional expertise' in community engagement could enhance engineers' capacity
401 to work with a wider range of disciplines to improve responses to wicked problems (Seager et
402 al., 2012). Interactional expertise is 'the ability to converse expertly about a practical skill or
403 expertise, but without being able to practice it, learned through linguistic socialisation among the
404 practitioners' (Collins, 2004). The principles provide a foundation for engineers to both improve
405 their own expertise and capacity to engage with communities, and to work more productively
406 through interaction with community engagement professionals and community representatives.

407

408 **7. Conclusions**

409 Engineers are increasingly called upon to work on 'wicked problems' for which there is no clear,
410 single technical solution (Seager et al., 2012). Designing and delivering infrastructure to support
411 sustainable development and respond effectively to the climate crisis requires collaboration with
412 diverse stakeholders, including local communities (Engineering Council, 2013; ICE, 2021).
413 Engaging local communities requires new understanding of the role of engineering in
414 infrastructure delivery, including how engineers work with community engagement specialists
415 and established community leaders.

416

417 The ICE Principles for Community Engagement with Engineering were drafted from established
418 literature, and finalised after consultation with civil engineers and interested stakeholders. The
419 Principles are intended to be adaptable to suit a range of contexts, sectors and scales of
420 project, and to support engineers at different stages of their career and levels of influence. They
421 provide a foundation for further development of best-practice case studies and guidance, to be
422 shared through engineering education and professional development.

423

424 Engaging communities in engineering and infrastructure is necessary for achieving sustainable
425 development. The Principles provide a shared statement of values to underpin how engineers
426 and associate professions work with local communities to realise positive benefits from
427 engineering and infrastructure, also fulfilling professional responsibilities for the health and
428 safety of the public and future generations.

429

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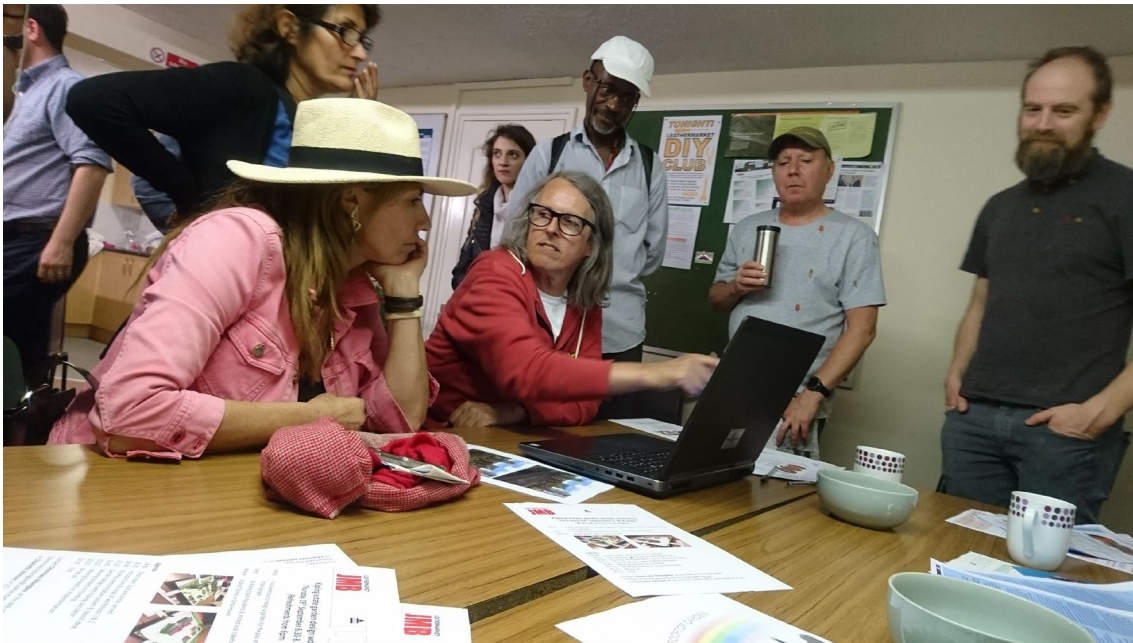
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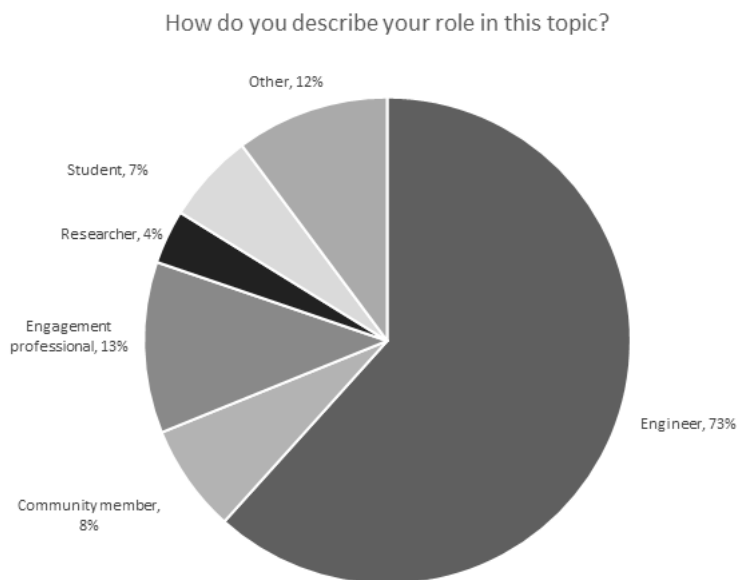
524 **Figures**



525

526 Figure 1. Residents of the Kipling Estate, London in a co-design workshop as part of the
527 Community Water Management for a Liveable London (CAMELLIA) programme (CAMELLIA,
528 2020).

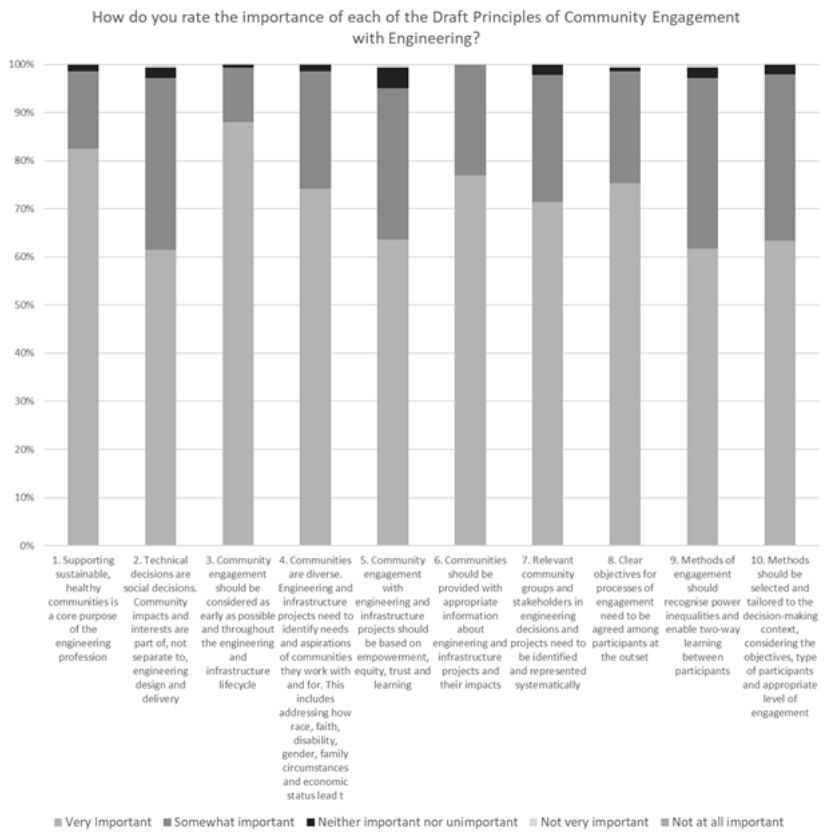
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530

531 Figure 2. Survey respondents' roles

532



533

534 Figure 3. Importance of individual principles