Above and beyond: ethics and responsibility in civil engineering

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ABSTRACT

This exploratory study investigates how nine London-based civil engineers have enacted 'global responsibility' and how their efforts involve ethics and professionalism. The study assesses moral philosophies related to ethics, as well as professional engineering bodies' visions, accreditation standards, and requirements for continuing professional development. Regarding ethics, the study questions where the line falls between what an engineer 'must do' and what 'would be good to do'. Although the term ethics did not spring to mind when participants were asked about making decisions related to global responsibility, participants' concern for protecting the environment and making life better for people did, nonetheless, demonstrate clear ethical concern. Participants found means and mandates for protecting the health and safety of construction workers to be clearer than those for protecting society and the natural environment. Specific paths for reporting observed ethical infringements were not always clear. As such, angalyses suggest that today's shared sense of professional duty and obligation may be too limited to achieve goals set by engineering professional bodies and the United Nations. Moreover, although professional and educational accreditation standards have traditionally embedded ethics within sustainability, interviews indicate sustainability is a construct embedded within ethics.

1. Introduction

The profession of civil engineering was founded on 'a moral imperative' (ASCE Citation2007, 10) to serve and benefit society. Since the early 2000s, engineering professional bodies have placed increasing focus on 'ethics', which ASCE has described as 'a branch of philosophy' defining 'right and wrong behavior' and investigating 'how people should act' (Committee on Education Citation2019, 17). This paper investigates how ethics have been framed, and engineers 'taught to act' vis-à-vis accreditation and continuing professional development (CPD). Accreditation and CPD constitute primary ways to infuse desired knowledge into a profession, the first by informing curricula and the second by requiring structured learning across an engineer's career. Looking beyond practical aspects and recognising that 'what counts'

(Downey and Lucena Citation2005, 252) as effective engineering knowledge shifts by time and place, we also explored relationships between moral philosophy and engineering ethics.

To investigate ethics in engineering, we conducted an exploratory qualitative study on engineers' perceptions of 'global responsibility'. To start, we reviewed the literature on the visions of change set forth by professional engineering bodies in the UK. Then, we collected interview data from nine engineers practising in London. We asked about their experiences enacting global responsibility and we probed their understandings of responsibility and ethics. We analysed their responses with regard to shifts desired by ASCE (Citation2007, Citation2009) the UK Engineering Council (Citation2004, Citation2013) and also the United Nations (Citation2020) goals for ethical and sustainable practice.

Perceptions of identity and responsibility vary across contexts, often along national lines, and key issues in teaching students about ethics involve relationships 'between the identity of the engineer and the responsibilities of engineering work' (Downey, Lucena, and Mitcham Citation2007, 468). Therefore, studying these issues in their natural context as a means to understand the lived experience of engineers in a given location is important. This study provides a first step and holds credibility as an exploration to map the existing terrain and inform future work. The following research questions guided our study:

RQ1) To what degree did ethics feature in London-based civil engineers' descriptions of enacting 'global responsibility'?

RQ2) To what degree did participant experiences align with UK accreditation standards and CPD requirements related to ethics?

RQ3) To what degree did narratives reflect various philosophical stances on ethics and responsibility, and what might this suggest for future development of professional standards?

A framework for assessing results was generated by exploring literature on (1) professional engineering institutions' (PEIs') evolving statements on ethics, (2) accreditation standards regarding ethics, and (3) licensure and CPD requirements regarding ethics, in addition to (4) philosophical stances on ethics in engineering.

Overall, participant narratives on global responsibility reflected an emphasis on sustainability with ethics embedded but rarely explicit. Participants readily associated health and safety (H&S) with global responsibility, but typically described ethics, anti-corruption, and bribery only when prompted. With regard to H&S and avoiding bribes, they expressed having very clear mandates, whereas other facets of corruption and how to avoid them were less obvious. Some important ethical decisions, it appeared, were being left to individuals rather than embedded in company policies and cultures. The discussion section of this paper unpacks this finding, and the recommendations section identifies implications for engineering education and practice.

2. Literature

Ethics and sustainability have been interconnected across time, often with one embedded within the other in professional statements and accreditation standards.

2.1. Professional statements and the overlap between ethics and sustainability

Civil engineering has tended to emphasise sustainability over ethics. The 2007 vision statement mentioned variants of 'sustainable' 32 times whereas variants of 'ethic' arose just 7 times (ASCE Citation2007). A survey conducted by ASCE as groundwork for this statement reflected a similar hierarchy. The survey asked world-leading engineers 'How important do you believe the following issues/developments/trends will be in impacting the civil engineering profession over the next 20 years?' (p.76). Scoring 8.30/10 (fifth out of 21 topics) was 'Engineering ethics and business practice ethics'. Concerns about the 'Number of civil engineers involved in the decision-making process for infrastructure policy' involved ethics implicitly and scored 8.40/10 (third place). The resulting vision statement described an ideal future reality where civil engineers would be 'universally recognized for their high ethical standards of practice' (ASCE Citation2007, 47). This would be achieved through 'greater education and training of engineers in ethics and a greater emphasis on ethics in global engineering practice' (p.25). Under this vision, civil engineers would 'serve competently, collaboratively, and ethically' (p.2) in a way that would specifically honour 'client confidentiality, codes of ethics within and outside of engineering societies, anticorruption and the differences between legal

requirements and ethical expectations, and the profession's responsibility to hold paramount public health, safety, and welfare' (p.11).

By 2007, notions of 'sustainability', 'sustainable development', and 'green building' had been gaining prominence across civil engineering and allied professions, all informed by an underlying sense of ethics and responsibility. Unlike ethics, very clear operating procedures were being introduced for sustainable development as early as 1990, when the Building Research Establishment (BRE) was launched to help guide decision making. This UK-based organisation released the BREEAM green-building rating system that became widely adopted in the UK and beyond (Building Research Establishment Ltd Citation2020). The United Nations followed suit with a focus on development, issuing the Millennium Development Goals in 2000, and the Sustainable Development Goals (SDGs) in 2015. When organisations and award programmeswere developed to encourage environmental sustainability and guide ethical decision-making, the word ethics often appeared tangentially.

Similarly emphasising 'sustainability' but leaving 'ethics' implicit were formal statements by presidents of the UK's Institution of Civil Engineers (ICE). Sustainability was a major theme of the 2006 ICE Presidential Address (Leiper Citation2006). Specific topics of the address were climate change, H&S, resource use, the organisation's people and how to make 'something happen' (p.1) by considering various perspectives. The word ethics appeared in a graphic presented during the speech, but not in the written transcript of the speech. Likewise, the 2009 ICE Presidential Address used variations of the word 'sustainable' 14 times, and 'professional ethic' once (Jowitt Citation2010). This mention was provided as advice to 'young engineers' to be 'well-mannered and considerate with high standards of proper behaviour' (p. 8).

Nevertheless, ethics were becoming more explicit in the UK. Working together in 2005, the Royal Academy of Engineering (RAEng) and the UK's Engineering Council issued a joint 'Statement of Ethical Principles'. The statement was updated in 2017. It specified the 'standard to which members of the profession should aspire in their working habits and relationships [and applicable] in every situation in which engineers and technicians exercise their judgment' (Engineering Council Citation2020a,

7). The two groups established, in 2019, a joint Engineering Ethics Reference Group (Engineering Council Citation2020a), in a move that suggests increasing concern for ethics and how to describe, convey and regulate ethics across engineering in the UK.

Operationalising specific principles in 2013, the UK Standard for Professional Engineering Competence, UK-SPEC (Engineering Council Citation2013) introduced a requirement for engineers 'to exercise responsibilities in an ethical manner' (p.7). The Spec's Statement of Ethical Principles promotes (1) accuracy and rigour, (2) honesty and integrity, (3) respect for life, law and the public good, and (4) responsible leadership, which explicitly involves listening and informing (p.33). These expectations apply to all fields of engineering in the UK. The aim was to regulate the profession of engineering by 'setting the standard for the practice of engineering and maintaining the registers of professional engineers and technicians' (p.2).

Ethics as a concept, practice, or set of ideal behaviours has been rising to the forefront. In the UK today this is most evident with regard to discussions and investigations of the tragic 2017 fire at Grenfell Tower. Reflecting a shift from the tradition of putting sustainably first, leaving ethics under the surface, in 2019 the ACSE asserted that 'Sustainability is part of the ASCE Code of Ethics and permeates all professional work of civil engineers' (Committee on Education Citation2019, 40). In this instance, sustainability was described as a subset of ethics. Situations like Grenfell underscored the necessity for this type of shift. As a result of that disaster, caused by the faulty cladding that had been installed based on inaccurate and intentionally falsified fire-safety test results, even greater emphasis is now being placed on how 'to make whistleblowing work for individuals, organisations and society', as indicated on the landing page of Protect (Citation2021), an organisation started in the UK in 1993 (then called 'Public Concern at Work'). Today the Engineering Council (Citation2020b) provides explicit 'Guidance on Whistleblowing', defining what it is, what obligations engineers have when a concern arises, what the legislations says, how to raise a concern, and where to get advice.

2.2. Accreditation standards regarding ethics

Universities were tasked to help achieve the envisioned transformation towards the more ethical and sustainable practice of engineering. To

influence UK education, specific components were added via UK-SPEC. The nation started implementing changes around 2003 and it soon adopted the UK-SPEC, which sets standards for education (Engineering Council Citation2004). At that time, the UK's Joint Board of Moderators (JBM) issued specific Sustainability Guidelines for bachelor's and master's courses (Dodds and Venables Citation2005). JBM debates and makes accreditation-related recommendations for the Institution of Civil Engineers as well as the Institution of Structural Engineers, the Chartered Institution of Highways and Transportation and the Institute of Highway Engineers.

UK-SPEC, in its past and current forms, applies to all three-year B.Eng. degrees that are part of a path towards Chartered Engineer in the UK. It also guides all M.Eng. degrees leading to Chartered Engineer, and all Bachelor's degree programs leading to the qualification of Incorporated Engineer (i.e. engineering technologists 'who maintain, manage and apply current and developing technology'). The specification document 'provides detailed guidance concerning the "threads" of design; sustainability; health and safety risk management; and professionalism and ethics – all of which are required by the JBM to be fully integrated within engineering teaching and learning' (Engineering Council Citation2013, 2).

To support shifts in education practice and help educators do more to promote sustainable and ethical understanding and ability among students, the RAEng has, since at least 2008, been developing and distributing educational tools and techniques (Bourn and Neal Citation2008).

Global trends are similar in that, since 2013, the Graduate Attribute Profile of the Washington Accord (WA) has required students to 'apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice' (International Engineering Alliance Citation2014, 15). The WA informs curricula worldwide and it states that students must 'understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts' (p.15). These expectations have informed various accreditation systems, including ABET in the USA and the Engineering Council in the UK. Thus, since the adoption of the WA, increasingly clear standards have been

implemented in civil engineering degree programs across the world, including the UK (Joint Board of Moderators Citation2018).

In the UK today, the Engineering Council (Citation2020c) provides a set of standards, ‘a framework for the assessment of the competence and commitment requirements for professional registration’ and ‘criteria that degree programmes must meet to be awarded accredited status’. This organisation sets the accreditation requirements for higher education engineering courses in a way that aligns with UK-SPEC (Engineering Council Citation2020d). The current standards specify six key areas for student learning. One is titled ‘economic, legal, social, ethical and environmental context’ and requires awareness of ‘the various legal and ethical constraints under which [engineers] are expected to operate’ and, more specifically ‘understanding of the need for a high level of professional and ethical conduct in engineering and a knowledge of professional codes of conduct’ (Engineering Council Citation2014, 13).

A new edition of UK-SPEC has been published for implementation during 2021 (Engineering Council Citation2020e). The number of learning outcomes has been reduced to increase focus on target areas, namely equitable and inclusive design, sustainability and ethics, security and mitigation of risks. Graduates at the Bachelors level must be able to ‘Identify and analyse ethical concerns and make reasoned ethical choices informed by professional codes of conduct’ (p.30).

There is increased recognition, originating in the US, that abilities related to ethics cannot be developed to the level needed during undergraduate years alone (Committee on Education Citation2019). Professional engagement and ongoing professional development are essential to developing and demonstrating such skills. According to new standards – specifically, the third edition of ASCE’s Civil Engineering Body of Knowledge, better known as CEBOK3 – graduating engineers should be able to: acknowledge the importance of ethical behaviour, identify and explain the ethical responsibilities of a civil engineer, and comply with applicable ethical codes (Committee on Education Citation2019). Higher-level abilities are intended to be developed following graduation, through ‘early career, mentored experience, which progresses in both complexity and level of responsibility’ (Committee on Education Citation2019, 152). Thus, it is not until after graduation that civil

engineers will be required to apply appropriate reasoning to an ethical dilemma, analyse ethical dilemmas to determine possible courses of action, or develop courses of action occurring in complex ethical situations. Other very high-level abilities are specified, but not necessarily expected to be achieved even during the period of structured mentorship. These are the ability to advocate for ethical behaviour in the practice of civil engineering, and the ability to assess courses of resolution to ethical dilemmas in complex situations.

2.3. Licensure and CPD requirements regarding ethics

Based on past efforts, one might expect recent engineering graduates to be entering practice with a heightened awareness of ethics and global responsibilities – fully understanding the role engineers play in achieving environmental, social, and economic sustainability – and equipped to act. Yet, developing the ability to discern and navigate through various ethical dilemmas may extend across a lifetime (Committee on Education Citation2019). Today, requirements related to ethics can often be found in licensure systems, and these increasingly involve maintaining an ongoing record of CPD in the years after graduation and professional credentialing.

In the UK, professional regulation is handled by the country's 35 licenced Professional Engineering Institutions (Engineering Council Citation2013). Only around 5% of engineers in the UK hold Chartership and although 'Chartered engineers represent only 5% of the engineering community, it is of the greatest significance that membership of the PEIs (including non-registered members) represent only about 15% of that community' (Uff Citation2016, 21).

Holding a degree is considered adequate for practice in the UK, and sufficient for signing off on most Certificates of Conformity, Certificates of Safety, Certificates of Design, and the like (Brinklow Citation2002). 'Engineer' is not a protected title and being Chartered is not required:

In general, there is no restriction on the right to practice as an engineer in the UK. However, there are a small number of areas of work, generally safety related, which are reserved by statute, regulations, or industry standards to licensed or otherwise approved persons. (Engineering Council Citation2020f, 7)

Around 100,000 professional engineers are members of one of the civil, structural, or transportation institutions overseen by the JBM (2017). Although not all members are fully Chartered, advice is available to members at all levels (e.g. student, graduate, technician, and associate, in addition to full/Chartered and Fellow). For those who want to become Chartered, earning a master's degree in engineering is essential. Chartership in civil and structural engineering has very clear requirements.

The current UK-SPEC identifies requirements and post-graduation CPD activities that must be met to gain certification (Engineering Council Citation2013). It encourages all PEIs to enact policies requiring CPD and to create systems for monitoring its members. CPD requirements thus affect all credentialed Engineering Technicians, Incorporated Engineers, and Chartered Engineers across the UK. Specific evidence is now required that certified professionals comply with the Code of Conduct of their respective institution, manage and apply safe systems for work, contribute to sustainable development, complete and record CPD to extend competence in their specific realm, and carry out their responsibilities in an ethical manner (Engineering Council Citation2013). UK-SPEC suggests ways that these requirements might be demonstrated. For instance, ability in sustainable development might involve operating and acting 'responsibly, taking account of the need to progress environmental, social and economic outcomes simultaneously' (p.12).

National policies have exerted pressure on PEIs to change. Whereas ICE had already been requesting roughly '30 hours of CPD per year up to the Professional Review stage [that confers Chartership] and then enough to develop and maintain the professional knowledge, skills and competence' (Continuing Professional Development Citation2014, 3), new national policies have increased the expectations and required new systems to enforce them. The Engineering Council (Citation2020g) requires all PEIs to make random samples of members' CPD records and to provide them feedback. The Institution of Civil Engineers (Citation2020a) explains how it is meeting this mandate. In January 2020, ICE requirements came into effect, requiring all professionally qualified members to update their Development Action Plans (DAPs) and Personal Development Records (PDRs) throughout the year. ICE now monitors these by way of an annual CPD Audit. ICE had been conducting random checks of members' CPD records since 2011, but expectations escalated.

Today, ‘if a member fails to submit their CPD records when requested as part of the annual audit, they will be removed from the membership roll and Engineering Council register’ (Engineering Council Citation2020b, 10).

Thus, a significant and growing emphasis on CPD is evident across the UK engineering policy environment, and ethics and sustainability are explicitly included in the requirements. However, the majority of established engineers are not Chartered, and they are therefore not be affected by these new CPD requirements. In fact, there are no levers available to force them to update or expand their knowledge.

2.4. Philosophical underpinnings of ethics

Relevant to this exploratory study within the realm of philosophy is literature on duties, responsibilities, the public interest, occupational H&S, corruption, and bribery. We have pulled these into separate sections below, because participants readily associated H&S with global responsibility but the words ethics, corruption, and bribery typically emerged only when raised by the interviewer. We investigated the philosophical underpinnings of each of these topics individually within the literature review below and then used the same format when reporting results and findings.

2.4.1. Public interest duties and responsibilities

To understand basic concepts of ethics in engineering, it is necessary to consider professional obligations and duties, as well as economic and political constraints. In engineering contexts, Ladd (Citation1982) explained, ethics have to do with a forward-looking sense of responsibility (asking what engineers ought to do, and more specifically, what are their duties?), rather than backwards-looking questions (like, who is to blame?). Philosophical literature related to ethics and responsibility tends to focus on duty, obligation, and requirements. Indeed, these terms are clearer than ‘responsibility’ and more explicit in what they mean. They make clear that something is required. It is not optional; it is something the engineer must do. There is a distinction between the responsibilities of individual engineers and the collective responsibilities of the engineering profession. For example, while only some individual engineers have the assigned responsibility to ensure the safety of drinking water in a particular community, engineers as a whole

have a collective responsibility to provide supplies of safe water for the planet.

Kant made a distinction between duties of justice and duties of beneficence – whereas duties of justice are perfect and clear, duties of beneficence are imperfect 'such that it is not always clear who owes what to whom in what circumstances' (Gilabert Citation2012, 12). Supererogation is the philosopher's technical term for 'the class of actions that go "beyond the call of duty"' (Heyd Citation2002/2019, 1). The term highlights the crucial distinction between there being a moral reason to do X, and the claim that one must do X. For instance, according to most people's common-sense morality, one has a moral duty not to kill people, but – although there is a good moral reason for charity – giving a portion of one's income to address famine is usually considered supererogatory, rather than one's duty. Some philosophers have challenged this conclusion, like Singer (Citation1972) who argued that ignoring famine is morally wrong:

We would not be sacrificing anything significant if we were to continue to wear our old clothes, and give the money [to prevent] another person from starving. … To do so is not charitable, or generous. Nor is it the kind of … act which it would be good to do, but not wrong not to do. On the contrary, we ought to give the money away, and it is wrong not to do so. (p.235)

A similar debate, between doing and allowing harm, is often discussed in terms of killing (doing) and letting die (allowing). A common view is that all engineers have a duty not to do harm and should not, for instance, dump toxic waste into a river that supplies a village's drinking water, regardless of the costs to the company of not polluting the water. In contrast, engineers do not have a comparable duty to save people from potential harms (assuming the harms were not caused by the engineers). Many believe the duty to avoid doing harm applies even in cases where the chain of causation is less straightforward. In engineering, the most obvious complication is risk. All civil engineers must assess the probability of doing harm, as nearly all projects hold some risk of harm. Although it introduces complications and shades of grey, one could argue that all engineers have a duty to avoid imposing significant risks of harm on the public. The Grenfell Tower fire provides one prominent example where engineers imposed an unjustifiable risk of harm on the

public. The SDGs illustrate that perpetuating standard construction practices puts the health of humans and other living beings, as well as the overall planet, at risk (United Nations Citation2020). Protecting the public interest inherently ties to protecting the environment and working to achieve holistic, long-term sustainability. It is a moral imperative.

Going beyond the duty to avoid doing harm, however, leaves considerable scope to debate an engineer's duty to prevent harm (by not allowing it to happen). For example, following Singer's (Citation1972) argument, one could argue that knowing about poverty and other problems (such as those raised by the SDGs), any person ought to act. If an engineer is aware of water shortages, lack of drinking water and basic sanitation, and resulting diseases and deaths, that engineer might have a duty to respond. Singer argued if a person can save lives 'without sacrificing anything of comparable moral importance' (1972, p.6) then the person is morally required to do so. Yet the implications of this view, and the demand it would impose on every engineer, indicate this view is radical. Despite the influence of Singer's work, it is accurate to say most moral philosophers do not agree with Singer. Chappell (Citation2009) and Lawlor (Citation2009) have provided views and arguments that contrast with Singer's. Regardless of what an individual might think about Singer's views, and where the line falls between duty and the supererogatory, various commitments have been made (e.g. the SDGs, the Paris Accord) that should be upheld, and engineers are a crucial part of the puzzle in achieving these commitments.

2.4.2. Responsibilities for Occupational H&S

According to the UK's Health and Safety Executive (Health and Safety Executive Citation2019) the construction sector comprises about 7% of the workforce. Due to evolving H&S practices and regulations, construction-related accidents and fatalities in the UK decreased, between 1987/88 and 2018/19, from 9.3 to 1.31 per 100,000 workers. The level of risk tolerated today is much lower than even a decade ago, and improvements have been dramatic. Yet, construction accidents still resulted in 37 fatalities (30 workers, 7 members of the public) in 2018/19. The rate of fatal injuries in the construction workplace was far higher than in either transportation/storage or manufacturing. To enforce safety, the HSE issues fines and brings to court companies that breach safety mandates. During the year before the 2018/19 report, 158

construction cases were prosecuted by the HSE, reflecting a drop from 202 the year before, yet 'Construction sector fines made up almost 30% of the total issued, second only to the manufacturing sector' (Rowland Citation2019, ¶7). There is clear room for improvement, but also an evident association between monitoring/enforcement and decreased number of accidents. Past success provides hope. Today, job-site safety is seen as everyone's responsibility, individually and collectively.

2.4.3. Responsibilities against corruption and bribery

Moral philosophers and professional bodies have highlighted widescale, societal implications of construction-related bribery and corruption. Vogl (Citation2012) argued 'corruption kills' (p.39), illustrating that in Haiti, contractors had sidestepped building codes by bribing officials. This led to calamity in January 2010 when a quarter-million people were killed by the earthquake-induced collapse of homes, offices, and apartment buildings.

Today's engineers sense a clear moral obligation to avoid doing harm via bribery and corrupt activity, but this was not the case even two decades ago. How was change achieved? At the end of the 20th century, it became increasingly clear that engineers had been complicit in corruption. In 2004, Institution of Civil Engineers (Citation2004/2012) acknowledged this view, stating that bribery and corruption produced 'wholly malign' effects, 'particularly upon the poorest nations' (p.7). ICE highlighted engineers' involvement:

In some parts of the developing world bribery and corruption in construction and civil engineering is so widespread that it has significantly reduced the number of infrastructure projects. This could not have occurred without the participation in bribery and corruption of contractors and consultants based in the developed world. (p.7)

Efforts to establish a clear and shared conception of corruption in the UK were documented in a paper by Stansbury and Stansbury (Citation2005) regarding 'unethical behaviour and criminal acts' related to construction. A group was set up by the Society of Construction Law in London in 2003 to stimulate debate, boost awareness, identify core principles of ethical conduct, articulate standards of compliance, and influence professionals of construction law. The group identified acts that should be considered ethical breaches – whether or not legally designated as criminal – and

made clear that ‘tender collusion, claims fraud, and deliberate supply of sub-standard products or incorrect quantities’ (p.iii) were to be considered fraudulent criminal offences, rather than just ‘part of the game’. As a result, refusing to accept gifts and kickbacks shifted from ‘going above and beyond’, or being supererogatory in the UK, to being expected.

Singer (Citation1972) would ask us to do more, and he is not alone. Consider contemporary discussions about ‘fair trade’ over ‘free trade’, where Wenar (Citation2008) has argued for creating ‘trade where now there is theft’ (p.2). Seeing unfair trade as theft shifts the sense of responsibility. By this definition, unfair trade steals and those who benefit from it carry guilt.

3. Design and Methodology

This paper reports a post hoc analysis of existing interview transcripts conducted for an existing study on global responsibility. The analysis encompassed all extracts from the existing transcripts that involved the words health, safety, ethics, corruption, and/or bribery. The project began as an exploratory study, and one primary request set the tone for each interview: ‘Please tell us about a time in your recent work when you’d say you made decisions related to global responsibility’. Interviewers did not define the term ‘global responsibility’ for participants but rather asked them to define it themselves.

3.1. Sample

Research Ethics at University College London (UCL) approved the project. Engineers without Borders UK (EWB) solicited participants via email, newsletters, and Tweets, and a webpage was available announcing the project (Appendix A). The online registration form requested basic demographic data and scheduling availability. To be included in the study, the participant was expected to have studied engineering, be employed in London, and be working in the realm of the built environment. All who volunteered and were available to interview within central London were included in the study. Participation was voluntary and participants were not offered any incentive or reward. As such, this study reports results of a convenience sample. The sampling method presented several limitations, discussed below. Nevertheless, the sample did include a spectrum of experience levels and did achieve

data saturation regarding participants' definition of 'global responsibility' (the aim of our larger study).

Ultimately, the research team conducted in-person, hour-long, semi-structured interviews with nine participants during the first quarter of 2019. Table 1 provides basic demographic data pertinent to this study; it is organised in ascending order of time in the profession. All participants were white Europeans (all but one were British nationals). The sample included three women and six men, and all but two graduated in engineering since 2010. Each had four years of engineering-related studies leading up to the diploma date listed. All had earned their engineering-related degrees in England, with one having done an additional master's course elsewhere in Britain. All but two held degrees that include the word 'Engineering'. All except for the research-focused participant (n = 1) were engaged in licensure; theyalready held Chartership (n = 5) in one of the 35 licenced PEIs in the UK or were aiming for it (n = 3, and one of these three gained Chartership since the interview). This reflects a significantly higher level of engagement with Chartership than is typical across engineering in the UK (Uff Citation2016). The sample also reflected a higher level of engagement with EWB than typical: four mentioned involvement with EWB (George, Charlie, Emma, Arthur) and one more (Thom) said he envisioned getting involved in EWB.