Holistic Engineering Ethics?

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Abstract

This paper focuses on the question of *What kind of engineering ethics (EE) is needed to develop holistic engineers who can practice and promote the principles of sustainable development?* It is argued that, given the existence of other models, an approach to EE, as argued for at EESD 2016, centred on "training engineers for handling ethical dilemmas in sustainability contexts" (Lundqvist and Svanstrom 2016) is inadequate to address the sustainability challenge facing engineers. It argues that while EE is now a diverse and fragmented field sociological tools can be used to understand this diversity. A framework is offered for understanding different approaches. This is used as the basis for arguing for a more extended and broad approach which allows us to focus on the relationship between social structure and human action and the need for "adequate social institutions and structures" (Becker 2012: 28) to enable ethical action. Thus engineers not should only understand the constraints and enablers emanating from the environments in which they work, but can also strive for change in these environments.

1 Introduction

According to Grasso and Helble (2010) holistic engineers need to address social needs and be ethically grounded. In many countries engineering educators are mandated to provide ethics education including the principles of sustainable development. Despite these mandates, research suggests that provision of ethics education in engineering is inadequate, discussion of cases focused on ethics dilemmas is the most prevalent means of teaching, and that "the broad public purposes of engineering receives little attention" (Colby and Sullivan 2008: 330). Our research on the integration of sustainable development in a number of Irish engineering programmes found that "it was not evident how commitment to SD values is generated in the programmes. Modules that focus on ethics focus on micro ethical issues and professional responsibilities as set out on the code of ethics" (Nicoleau et al. 2018: 32).

In light of the dissatisfaction with the dominant approach, there is an increasing variety in approaches to EE (see Conlon and Zandvoort 2010). Therefore, it seems surprising that at EESD 2016 the only paper to deal substantially with EE should propose an approach based on "training engineers for handling ethical dilemmas in sustainability contexts" (Lundqvist and

Svanstrom 2016). While the authors are aware of the problems associated with the use of an approach focused on ethical dilemmas we are not convinced that their approach overcomes the limitations associated with this dominant approach or addresses the demand for a refocusing of EE to address macro ethical issues and the broader ethical obligations of the profession, such as those embodied by sustainability.

This paper will proceed as follows. Firstly, the traditional approach, including the approach of Lundqvist and Svanstrom, and its limitations will be discussed. We then briefly identify a number of alternative approaches which can be found in the literature. This provides the basis for arguing for an integrated approach to sustainability ethics which pays attention to the institutional context in which engineers work.

2 Engineering Dilemmas

In previous work (Conlon and Zandvoort 2011, Martin, Conlon and Bowe 2017) we have identified some of the problems associated with the traditional and dominant "individualistic" approach to EE This approach focuses narrowly on the ethical commitments of individuals, uses case studies to "train" students to be morally sensitive and resolve ethical dilemmas, and sees whistleblowing as a key device for ensuring that engineers can remain true to their ethical codes. Some key features of this approach are:

1. There is an almost exclusive focus on individuals who are facing a dilemma and from whom an ethical decision is expected involving a challenge to the interests of the organisation in which the engineer works. A key objective is to improve their ethical awareness and will power. A problem here is that "ethical awareness has not been demonstrated to translate into ethical behaviour" and "many ethical dilemmas engineers face are predominantly outside his or her control" (Bairaktarova and Woodcock 2017:1129,1143).

2. Codes of ethics, as standards of responsibility, are assumed to be the main source of rules that guide ethical decisions. It is implicitly assumed that these rules are sufficiently clear and free of conflicting elements to be applied to particular cases. If for some reason elaboration of the rules provided by the ethical codes is considered necessary, this approach falls back on traditional moral philosophy for help.

3. There is an assumption that "win-win" or "creative middle way" solutions, where one must choose among two or more conflicting morally important values, always exist and can be implemented by individual engineers. Key problems with this include the assumption that win-win solutions exist for ethical problems that engineers encounter and that individual engineers

can implement their proposed solutions. The scenarios used do not faithfully reflect how engineers actually practice engineering. The focus is on small-scale human interactions, while ignoring the ethical problems of multi-actor situations that frequently arise within the context of engineering and technology.

4. Arising from the above there is a neglect of the macro-ethical problems of the profession (Herkert 2005). A problem here is that this approach is about providing students with an understanding of the nature of EE: "the value of engineering ethics rather than the values of an ethical engineer" (Shuman et al 2004). This is a call for value neutrality and is based on the contradiction that while we want engineers to practice engineering ethically we do not seem to want them to commit to any particular set of values. A shift to a focus on macro issues will require that engineers reflect on and commit to the goals of engineering which should be realised through engineering practice and public policy (Son 2008).

It can be argued that the commitment to value neutrality, the focus on the individual engineer and the bracketing out of the wider context are linked. This approach rarely calls on students to question the context from which dilemmas arise. The options provided to students rarely "entails permanently changing any social arrangements…and there are no analyses of how the social arrangements for making this decision could be changed in various ways" (Devon and Van De Poel 2004:463).

In their paper Lundqvist and Svanstrom (2016) acknowledge the difficulties for teachers in integrating ethics into the engineering classroom and seek to provide guidance on how ethics can be integrated into engineering education. Their approach is focused on the use of ethical dilemmas which, they say, "can be an effective tool in education to support students' motivation and learning about ethics, since they give an opportunity for students to deal with issues they can face in their profession" (196). They are aware of some the issues that have been raised about the use of case studies in EE and approvingly draw on Lynch and Kline (2000) to argue that cases should "be formulated to reflect the complex and open conditions that exist in engineering practice to make them the most effective in education" (197).

Yet in their focus on theory "in terms of what characterises an ethical dilemma, different ethical theories, and on how to apply ethical theories to manage ethical dilemmas" (199), their suggestion of using "stripped-down" ethical dilemmas and their focus on students making "informed evaluation of…potential ethical concerns, based on ethics theory, and construct arguments for how to act" (201) they seem to be advocating an approach to case studies which

is the very focus of Lynch and Kline's (2000) critique. Lynch and Kline are critical of approaches based on the simple application of moral theory. They suggest that what takes place in the ethics classroom is a mistaken attempt to embolden engineers against unethical employers: "A solid grounding in moral philosophy, a personal moral code, and a commitment to professional responsibility are assumed to inoculate us from the weakness of will" (Lynch and Kline 2000: 207). They argue for a move away from agency focused accounts of ethical failure and argue for cases (both large and small) to include more contextual detail; to "expand casuistry's focus to include more *actions*, and more *agents*"(198-9); to provide a more realistic understanding of engineering practice; to encourage students to understand the need for persuasion and engage in role-playing so that they can understand the perspectives of others and the constrains in which they act. Large case studies should include topics related to activities beyond the technical such as contracting, regulation and technology transfer.

The "individualistic" approach can be useful for getting students to reflect on the nature of moral decision-making and highlighting the manner in which the operation of corporate decision- making can clash with the requirements of good engineering. But in focusing solely on an individual engineer's possible courses of action, these case studies tend to be uninformative about the social, organisational and political complexities of engineering practice. For example, rather than looking for the causes of accidents in the moral failings of individuals, it is more productive to focus on the social and organisational properties of the overall sociotechnical system (Conlon 2015). Accidents have an historical background and an unfavourable organisational context in as much as a number of decisions and unfavourable circumstances progressively generate a pre-accident situation long before the triggering of the accident itself. We can identify recurrent features of organisational accidents all of these were present in the case which Lundqvist and Svanstrom want to strip back in order to teach students about moral theory. So, for example, in their analysis of the Pinto case Lee and Erdmann (1999) say that some engineers reported that those who had reservations about the safety of the Pinto "believed themselves powerless to challenge the prevailing "acceptable risk" definitions" (39). A key legal judgement in the case, the Appeal Court decision in Grimshaw v Ford, said "Ford's institutional mentality was shown to be one of callous indifference to public safety."2 Much is lost if students come to hold narrow views about how moral dilemmas can be resolved or if they believe that engineers are to meet their obligations to the public "regardless of any pressure they may encounter working in a corporate environment" (Lynch and Kline 2000: 197). By not

taking adequate account of these pressures there is a danger of moralism as unrealistic expectations are placed on engineers.

2 In an article in the New Yorker Malcolm Galdwell describes how the culture in Ford changed a young engineer, Denny Gioia, who worked in Ford during the Pinto controversy: “Gioia says he went to Ford with the idea that he would “fight them from the inside,” but sooner or later, inevitably, the world that surrounds us, all the working day, takes precedence. “Here’s the guy that went in with a strong value system, with intent and purpose, and got flipped within the space of two years,” he went on. “If it could happen to me, it could happen to anybody.” In light of these problems with the “individualistic” approach a number of other paradigms have emerged.

There have been calls to replace the dominant approach with a greater focus on macro ethical issues; to focus on the daily routines of engineering practice; to adopt approaches based on social ethics or aspirational ethics; and/or to engage with the philosophy of technology or with Science and Technology Studies (STS) (see Conlon and Zandvoort 2011). Given a divergence in approaches it is necessary to develop tools to understand these different approaches and how they might relate to each other.

3 Alternative Approaches

The emergence of alternative approaches are attempts to address different problematic aspects of the dominant approach by seeking to contextualise case studies better or by integrating macro issues more fully. Given the focus within the literature on the requirement for a macro focus we use a framework developed by George Ritzer (2001), for understanding different paradigms in social analysis, to analyse approaches to EE (Fig 1).

<table>
<tr><th colspan="4">Macroscopic</th></tr>
<tr><td rowspan="2">Objective</td><td>i. Macro-Objective:
Focus on social, economic and political structures and public policy</td><td>ii. Macro-subjective:
Focus on goals and values of the profession</td><td rowspan="2">Subjective</td></tr>
<tr><td>iii. Micro-objective:
Focus on engineering practice and role of organisational culture and processes</td><td>iv. Micro-subjective:
Focus on consciousness of individual engineers: their ability to identify and solve ethical dilemmas and their ethical will power</td></tr>
<tr><th colspan="4">Microscopic</th></tr>
</table>

Figure 1: Levels of analysis in engineering ethics

The framework is based on four levels of analysis which emerge from the interaction of two social continua: the *macro/micro* (the magnitude of phenomena) and the *objective/subjective* (whether a phenomenon has a material existence, or exists simply in the realm of ideas and knowledge). Given the variety of approaches to engineering ethics, Ritzer's framework provides a useful tool for analysing current approaches. In using it, our focus is on capturing the fundamental image of the subject as presented by each paradigm. Space allows for only a cursory examination of the different approaches. The main elements of Paradigm iv have already been discussed so features of the other three approaches are discussed below.

3.1 Micro-objective

In order to address the context of engineering practice, some have argued that EE should be informed by STS. One focus in this approach is on *why* accidents happen in engineering projects. The explanation is usually sought within the prevailing organisational culture and processes with exemplary work being Vaughan's (1996) analysis of the Challenger disaster. In explaining the disaster, she emphasises *institutional logics* and the manner in which patterns of behaviour developed and became institutionalised within the organisations supporting the Shuttle programme. Vaughan discusses how risk came to be redefined, leading to a number of launches with a flawed design. This led to what Vaughan calls the "normalisation of deviance".

In a significant contribution to the EE literature, Lynch and Kline (2000) draw on Vaughan's analysis to argue for a focus in EE on the *detail* of engineering practice and the *role of organisational culture and processes*. Their aim is to explore how engineers can learn to identify features of their practice that potentially contribute to ethically problematic outcomes *before* clear-cut dilemmas emerge: engineers should exercise imagination to prevent these problematic characteristics from developing in their practice. While this approach can be welcomed as it moves us away from simplified case descriptions lacking their organisational and social context it is not without problems.

Firstly, although Vaughan pays attention to the wider economic and political environment, including budgetary pressures, in which NASA operated and the way it reinforced the normalisation of deviance, Lynch and Kline's focus is mainly on the organisational culture. This is perhaps unsurprising. Although Vaughan is aware of the significances of wider macro questions of domestic and international political economy her analysis focuses mainly on the micro-processes of decision-making. By not problematizing this context, and exploring how it might be different she ends up accepting the social inevitability of mistakes. Further there are

difficulties in the manner in which Vaughan understands the relationship between forces operating at different levels. She sees individual behaviour as shaped by overwhelming macro forces. Her emphasis is on the integrating role of the organisational culture leaving little room for change, protest and resistance (Conlon 2015a).

Secondly, Lynch and Kline fail to specify how engineers who become aware of the normalisation of deviance are to change the problematic aspects of organisational practices. It is perhaps ironic that in drawing on Vaughan, who has a structuralist bias, Lynch and Kline end up with an overly agency focused view.4 Their approach remains focused on the moral responsibility of engineers and less on the changing the institutional environment in which they work. Some (Swierstra and Jelsma 2006) have argued that the picture painted by Lynch and Kline is too rosy and call for "an institutional ethics": a focus on the relationship between individual moral agency and the individual's enabling and constraining environment.

4 But see Lynch (2015) where he responds to this criticism.

3.2 Macro-Subjective Approach

Drawing from the philosophy of technology, Son (2008) has argued that a shift to a macro focus, should lead to a questioning of the goals of engineering or current forms of technological development: ''…engineers will be obliged to reflect on what kind of society is desirable, to produce sound arguments for their ideas, and to conduct and justify their engineering practices accordingly" (413).

In this spirit, and drawing on the tradition of virtue ethics, Bowen (2009) calls for an "aspirational ethics". He states that ethics may be seen as *aims* of a life that can be regarded as good, and morality as *norms* that provide articulation of these aims. Rather than focus on the resolution of moral quandaries "an essential antecedent approach is to adopt a positive way of being the very nature of which helps to minimise the occurrence of such difficult situations" (85). He argues that EE has focused, to date, on *morality* and suggests that engineers have, to a significant extent, forgotten that their primary objective is the promotion of human well-being. What is needed is the development of a genuinely aspirational ethical ethos which prioritises human flourishing through contributing to human well-being. Bowen argues that engineers have not engaged sufficiently in any ethical analysis of their activities; he suggests that engineers themselves need to adopt a positive way of life and take responsibility for the outcomes of their activities. A person who "genuinely possesses a virtue would be expected to manifest it through the range of his or her activities" (p. 79). Two issues arise.

Firstly, the main emphasis, for Bowen, is on the *culture* of engineering and the development of an aspirational ethos which prioritises human flourishing. An issue then is what criteria are to be used to measure human flourishing. Secondly, there is a danger here of moralism. While engineers *may* be committed to ethical practices it is not always *possible* to behave ethically. To exercise moral agency, commitment to particular outcomes *is* necessary, but so is the power to achieve these outcomes. In later work Bowen (2014) pays some attention to this issue emphasizing the importance of a supportive social context. This highlights the need, in raising the level of analysis, to address both the goals of engineering and the capacity of engineers to practice engineering in a way that promotes human flourishing.

3.3 Macro-Objective Approach

As seen above Swierstra and Jelsma (2006) have argued for an institutional ethics. While not wanting to abandon a focus on the responsibilities of engineers they argue that an EE that takes responsibility to heart needs to reflect upon the conditions in which responsibility can be exercised. They argue that a sociologically informed way of studying engineering practice can help engineers to recognise the possibilities and obstacles for assuming social responsibility for their work. They believe it is both necessary and possible to influence the institutional environment of engineers so as to enable them to behave responsibly. The manner in which they can do this "should be part and parcel of engineering ethics" (2005: 225).

In a similar vein Zandvoort et al. (2000) have argued that engineers need to accept that they must play an active role in helping to reshape the context from which ethical problems arise. It is possible to identify two broad approaches to facilitating change in the environment in which engineers work. The first would seem to accept that the current organisation of production and consumption *can* be reformed through regulation to give support to engineers. Some approaches (Zandvoort 2005) have focused on specific changes in the structures of corporate and management accountability and proposed wide ranging changes to legal systems to enable socially responsible behaviour and the promotion of sustainability.

The second questions whether the goals of sustainability and social justice can be met within the confines of current relations of production and consumption. Some have argued that legal reforms are not enough, that we need a wider focus and that there are contradictions between the goals of engineering, such as sustainability, and current political and economic priorities (Petrella 2001, Weiler 2001). Further the promotion of overconsumption undermines efforts to promote more sustainable patterns of consumption (Woodhouse 2001). Thus sustainability

requires that the profession influence change in "social, political, economic, and institutional paradigms" increasing our ability to move in sustainable directions (Donnelly and Boyle 2006: 153).

A Conclusion

This short review of approaches to EE has moved from an approach that emphasizes the capacity of engineers to exercise social responsibility to one where the actions of engineers are significantly constrained by the contexts in which the work. The framework used allows us to see that a macro-focus should involve interrogating both the goals of the profession and the social context in which engineers work. This should allow us to avoid a moralism that may burden engineers with responsibilities they cannot meet, while allowing us to better identify those circumstances which would facilitate the attainment of broad goals such as enhancing human welfare and sustainable development.

This suggests that, analytically, the key focus should be on the relationship between the agency of engineers and the social structures in which they work, and the extent to which they constrain or enable a socially responsible engineering practice, rather than on the scale of the issues that EE addresses, which is the focus of the macro/micro debate. One good reason for saying this is that it is not always easy to distinguish the micro from the macro as they are intertwined and depend on each other. Herkert (2005) has, for example, identified the design of safe products as a micro issue. But the safety of engineering products and processes is affected by the attitudes, practices and organisation of engineers, organisational structures and culture, the regulatory regime, production pressures and public policy, which includes policy on product liability which Herkert identifies as a macro issue.

It would seem then that the key issue is not just the scale of the issues which EE addresses but how different mechanisms, operating at different levels, come together to produce particular effects in the practice of engineering. In this the commitments of engineers and the goals of the profession matter. But so does the context in which engineering takes place. Frameworks that attempt to link these issues can be found in work on sustainability ethics, drawing on the virtue ethics tradition, which rejects traditional approaches to moral philosophy, based on consequentialism or duty ethics, recognise that humans are embedded in many unchosen relations of unequal power and that a key challenge for sustainability ethics is to focus on "what structures and institutions govern these relations…and how we should design them to allow for an ideal organisation and realisation of the sustainability relations" (Becker 2012: 34).

In doing so we can draw on a key insight of STS which is that engineers do not just produce technology, but socio-technical systems which shape human activity (Johnson and Wetmore 2007). Thus engineers' ethical responsibilities are wider than traditionally understood. Further, they must engage with other actors who are responsible for the development of socio-technical systems. Therefore, we need a wider focus which places engineering practice in its wider context but does not eliminate an active role for engineers in changing that context as necessary (Conlon 2015a). The focus in ethics education must be on generating commitment to larger systematic change to established practices over time rather than on heroic responses to management wrongdoing (Lynch 2015). This will require engineers to engage with public policy and the extent to which it enables an engineering practice committed to human welfare and sustainability. This takes us far from training engineers to deal with ethical dilemmas as a focus for EE.

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