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Directing engineering ethics training toward practical effectiveness

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ABSTRACT

Engineering ethics tends to conceive itself as a form of professional ethics. Recently it has been challenged to become broader and more practically effective. By analysing and reflecting on this challenge and drawing on resources from the fields of Western philosophy of technology and STS, this article proposes a model of practical effectiveness with interpretation, operation, and dialogue in engineering ethics education.

1. Introduction

The occurrence of serious engineering disasters has attracted the attention of academia as well as the public. It is often argued that one cause of these disasters is insufficient ethical awareness and social responsibility on the part of engineers who lack a good education in engineering ethics and the ethical factors involved in their professional requirements. In regard to the teaching of engineering ethics, questions have also arisen about practical effectiveness. Practical effectiveness here refers both to the way engineering ethics is taught and to the extent to which what is taught is useful or can be applied in practice. The practical value of engineering ethics is thus a significant issue that engineering ethics needs to address. Practical effectiveness (including engineering ethics education and the cultivation of engineers' practical ability to apply engineering ethics in professional activities) is an important theoretical and practical issue.

One of professional ethics approaches in engineering ethics studies attempts to standardize ethical principles and moral norms, and then considers how to apply these principles and norms in engineering practice [1]. This has made great contributions to promoting engineering professionalism, enhancing engineers' awareness of responsibility, and stimulating professional autonomy. However, as science and technology are increasingly woven into society, this approach encounters certain challenges. With rapid changes taking place in the socio-technical environment, relatively changeless ethical principles are often inadequate for dealing with new problems. Engineers may be at a loss about what to do when faced with new professional moral dilemmas.

The Western philosophical schools as diverse as hermeneutics, practical philosophy, and discourse ethics, along with new characteristics in assessment orientations, decision-making patterns, and risk governance in engineering, are influencing the developments of contemporaryengineering ethics. Recent contributions to engineering ethics include the ethical turn of the Dutch School [2] in the field of engineering philosophy, the principle of *plus respicere* or taking more into account proposed by Carl Mitcham [3], and Joseph Herkert's argument for macro-ethics [4]. Engineering ethics studies from the perspective of practical effectiveness will draw on these intellectual resources in a framework that promotes application into new situations of engineering practice. The framework of practical effectiveness we propose involves three elements: interpretation, operation, and dialogue. A general sketch of this framework is first proposed, followed by a more detailed explanation of approach for each element. A conclusion considers the value and prospects for this framework along with some possible problems.

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2. A model of practical effectiveness: interpretation-operation-dialogue

What is the relationship between interpretation, operation, and dialogue in regard to practical effectiveness in engineering ethics? Firstly, it is essential to have effective communication between ethicists and engineers which can generate engineering ethics ideas and have them understood by engineers. The communication depends on the interpretation between ethicists and engineers. Secondly, engineering ethicists and engineers must collaborate to operationalize ideas of engineering ethics. Thirdly, engineering ethicists, engineers, and other stakeholders need an effective dialogue mechanism when they face ideological disagreements and conflicts of interest. And, the development of these three elements is thus required to pursue practical effectiveness in engineering ethics.

Interpretation in engineering ethics is not unidirectional either by ethicists or by engineers but interactive between them. Ethicists and engineers will both have to do some interpreting of ethics and of engineering — both for each other and of what each other have to say about ethics and engineering. Without such interpretative interactions ethics education and professional training will remain opaque to each other. Some ethicists do not have enough communication with engineers to grasp the details of engineering practice; their work is thereby limited to theoretical perspectives that are not always obviously useful to engineers. An interactive interpretative activity involving both engineers and ethicists as proposed here will move toward a fusion of the engineers' professional perspective [5] and ethicists' social perspective [6].

Operation in engineering ethics does not refer primarily to technical operations in engineering practice, but to the practical effect of ethical principles in technical operations achieved through various approaches, procedures, or methods. But there is an intentional double meaning here: Ethics needs to be operationalized by involving it with engineering operations. In the past, engineering ethics often emphasized the influence of ethical ideas on engineers' minds with insufficient attention to their influence on engineering practice. But engineering ethics can work only when ethical ideas can be operationalized by engineers. This working or operating of ethics can take place at different phases of engineering practice. For instance, using the upstream-midstream-downstream distinction, the midstream stage (mainly referring to the engineering design stage) has been a prominent focus of attention [7]. Operational midstream [ethical] modulation in engineering practice depends on the cultivation of moral sensitivity and moral imagination [8] along with effective decision making as new situations arise. Another way of talking about operationalizing ethics notes how technological mediation calls for embodying positive ethical values into the midstream stage to enable artifacts to function as materialized morality([9], p. 41) in the downstream use stage.

As already suggested both interpretation and operation depend on effective dialogue between ethicists and engineers, dialogue, however, in engineering ethics needs the public participation in order to deepen the understandings of all parties in ways that can improve interpretation and operation. Adopting the discourse ethics of Jürgen Habermas [10], the dialogue in engineering ethics can be divided into three different levels: professional dialogue, public dialogue, and institutional dialogue. Professional dialogue aims at ensuring justice in distribution of benefits in engineering projects; public dialogue deals with the real-time monitoring engineering practice in the level of social consensus; and institutional dialogue is devoted to the protection of public interest institutionally.

Interpretation, operation, and dialogue in engineering ethics are not mutually exclusive elements or activities, but work together. The operation in engineering ethics builds on Interpretation. The Interpretation in engineering ethics develops individual understandings through dialogue between ethicists and engineers, which will be in part about operations. Dialogue is further presented within interpretation and operation. Indeed, dialogue is necessary to investigate the whole social and historical context of any engineering project.

3. Interpretational approach

Interpretation in engineering ethics takes place in the presence of professional biases. Even when engineers receive engineering ethics education, it can be difficult for them to think about ethical issues broadly. Ethicists may blame engineers for their narrow professional perspectives and insensitivities without recognizing their own. Therefore, the interpretative activity in engineering ethics as elsewhere needs to highlight inter-subjectivity [11], enabling the two sides to remain open minded in ways that can overcome the restrictions of their professional knowledge structures by listening attentively to interpretations from each other.

Such an interpretative activity will expand the content and context of both ethics and engineering. In respect to content, ethical principles and moral norms, ethical feelings, ethical behaviours, and social impacts will all need to be clarified in the interpretational process. Engineering ethics education often emphasizes ethical principles and moral norms, but slights ethical feelings, ethical behaviours, and social impacts. The interpretational process needs to pay explicit attention to feelings and emotional factors along with such factors as moral consciousness, cognition, imagination, expectation, and intuition. Most theories of engineering ethics take the public good as an ultimate value but engineers do not always know what the common good is or fail to understand how engineering practice influences it.

In respect to context, there exist professional, technical, and policy contexts. In the professional context, ethical dilemmas often arise as conflicts between professional autonomy and business profits. When engineers realize that a project poses potential risks to the public, to what extent do they have obligations to communicate this to supervisory agencies or the public? In the technical context, where engineering design is central ([12], p. 147), ethical problems readily arise as a result of innovation. In the policy context, it is important to understand the broad impacts of engineering program in the global context and social context ([13], pp. 145–146).

Interpretation in engineering ethics will need to deal with a number of methodological issues. Firstly, the texts of interpretation ought to be chosen appropriately. These can include the specification of ethical principles and moral norms by case analysis, detailed discussion of engineering ethical problems relevant ethical principles and moral norms, and related social and cultural contexts. Some textbooks emphasize the analysis of ethical problems in catastrophic engineering accidents. Even though their conclusions are thought to be inspiring, they considerably differ from the practical situation of most engineers. Secondly, What Hans-Georg Gadamer terms *Vorurteile* or prejudices are influential on any interpretative activity; interpretative prejudices cannot be avoided so that critical reflections on them are indispensible ([14], p. 273). Especially for ethicists and engineers with their great differences in professional knowledge structure, it is even more necessary to reflect critically on the prejudices they bring to any interpretation. Thirdly, to promote what Gadamer calls a “fusion of horizons” among engineers and ethicists, it will be essential to engage their respective horizons and social roles. For example, a case such as the *Challenger* disaster that is given different explanations by different