Deciding on Ethical Issues in Engineering Design

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Abstract Engineers make decisions concerning ethical issues like safety and sustainability in design processes. We argue that the way in which engineers deal with such ethical issues depends on the kind of design process they carry out. Vincenti distinguishes between normal and radical design. In normal design processes the operational principle and normal configuration are given, in radical design processes they are not given. We present four case-studies of actual design processes: two processes of normal design and two of radical design. We show that in the normal design processes, engineers use what we call regulative frameworks to make ethical decisions. Regulative frameworks consist of legislation and technical standards, and interpretations thereof by certifying organizations. Operationalizations of ethical criteria are given in these regulative frameworks. Regulative frameworks also define some minimal requirements on safety and sustainability that the product should meet. In the radical design processes, such frameworks are absent or difficult to apply. Morally warranted trust in engineers can therefore not be based on regulative frameworks in the case of radical design; for radical design a different basis is needed on which to base such trust.

1 Introduction

Engineering design is fraught with the need to make ethically relevant choices. Suppose, for example, that you are designing a printer/copier. During the design process, a choice will be made as to whether the printer/copier will be able to print two sided or not. Once a choice is made for two sided printing and copying, an additional choice needs to be made about the default properties. If two sided printing is the default option, users have to make an explicit choice to print one sided. This default option will probably save a lot of paper compared with a printer/copier that can only print on one side. While the environmental effects of saving paper by

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P. E. Vermaas et al. (eds.), *Philosophy and Design*.

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printing two sided copies for a single printer/copier are limited, the global effects for the total number of printers/copiers in use is enormous. As paper is produced from wood, a reduction in paper use will also reduce the amount of wood used. The production of paper, the transportation of wood and the transportation of paper all require energy. The amount of energy used in the process will also be reduced and the total reduction in resources used will be significant on a global scale.

This example shows that decisions made during the design phase of a product, that might seem trivial during that phase, can have large environmental effects. Such environmental effects are ethically relevant because protecting the environment and sustainability are moral issues. Looking at sustainability questions such as: what is our responsibility towards future generations? and do ecosystems have intrinsic value? need to be answered. When engineers make decisions about sustainability during a design process they implicitly take a stance on these issues. For example if the one sided option is chosen for the printer/copier then future generations will probably have to deal with more environmental problems because more (fossil) energy and trees have been used.

We will call certain issues ethical if moral values are at stake. The central moral values we focus on in this contribution are safety and sustainability. In the case of the printer/copier, the moral value of sustainability seems to require unequivocally the choice for a device for which two sided printing is the default option. Often, however, moral values will come into conflict during a design process: the option that is the safest for example, might not be the most sustainable one (cf. Van de Poel, 2001; Van Gorp and Van de Poel, 2001). In such cases, trade-offs between different moral values have to be made. How to make such trade-offs in an acceptable way is in itself an ethical issue.

In this paper, we argue that there is an important difference in the way engineers deal with ethical issues in normal and radical design processes.[1] More specifically, our claim is that engineers use regulative frameworks to decide on ethical issues in normal design, while in radical design processes such frameworks are absent or inapplicable. To substantiate this claim, we present four case studies of design processes: two normal and two radical. The two normal design processes were one, designing piping and equipment for the chemical industry and two, designing a bridge. The two radical design processes were one, designing a sustainable lightweight car and two, designing a lightweight trailer to transport sand. These case studies were carried out by one of the authors (Van Gorp, 2005). The methods used for data collection included observing design teams, reading design documents and interviewing engineers.

In the following section we will present Vincenti's distinction between normal and radical design and introduce the notion of a regulative framework. Descriptions of the four case studies are given in section three. We end the paper with a discussion and conclusions including the moral implications of the results.

[1] See Van de Poel and Van Gorp (2006) for a comparable claim. The claim we make here is more specific, and we present some new cases.