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Moral judgment into moral action: Enhancing the teaching of engineering ethics

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ABSTRACT

CONTEXT

A recent review of the Australian Qualification framework (AQF) identified ethical decision making as a key capability for future graduates at AQF level 8. Further, ACED Engineer 2035 report also identifies ethics, trust, and ethical decision making as key for the future engineer. While most Australian universities incorporate Ethics as part of their engineering curriculum, very little consideration is given to models of ethical decision making. This paper makes recommendations for improving the current teaching practice of engineering ethics.

PURPOSE

The purpose of this paper is to examine and enhance current teaching practices of engineering ethics using ethical decision-making models as a basis for the improvement.

APPROACH

The approach consists of 1) analysing current teaching practices for engineering ethics as described in the literature, against models of ethical decision making, 2) identifying gaps that would better prepare students for ethical decision making, and 3) making recommendations to enhance current teaching practices.

OUTCOMES

The analysis of the literature highlighted that current teaching practices focus on ethical judgment making rather than ethical decision and action taking. Using models of ethical decision making, the analysis focused on two areas that would better facilitate judgment turning into action. They are 1) the situational context of the ethical issue, in particular the organisational context, and 2) the moral capacity of individuals.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

This paper offered recommendations to supplement existing teaching practices of engineering ethics by considering two important moderators of ethical decision making, the situational context and individuals' moral capacity to carry a judgement into action. The two moderators are components of a widely used ethical decision-making model and are not currently considered in existing engineering teaching practices.

KEYWORDS

Ethic decision making, ethics in engineering practice, ethics education.

Introduction

In September 2015, Volkswagen received a notice of violation of the Clean Air Act from the American Environmental Protection Agency. Volkswagen used “defeat devices” on millions of its diesel cars to falsify car emissions. Software was embedded in the devices and used steering wheel position, speed, engine operation and air pressure to determine whether a car was in test mode, in which case emissions control would be switched on. Under normal driving conditions, the car would operate “normally” which would result in 40 times more nitrous oxide being released. Allegedly, engineers designed and implemented the software in the “defeat devices”, raising concerns around ethical practice in the engineering profession (Rhodes, 2016).

A recent review of the Australian Qualification framework (AQF) identified ethical decision making as a key capability for future graduates (Noonan et al., 2019). The Australian Council of Engineering Deans (ACED) recently released its Engineer 2035 report, and also identified ethics, trust, and ethical decision making as key for the future engineer (Crosthwaite, 2019).

Most Australian universities incorporate Ethics as part of their engineering curriculum, however, there is great diversity in the way Ethics is delivered. There is often great reliance on the Engineers Australia Code of Ethics (Engineers Australia, 2019). The Engineers Australia Code of Ethics makes four broad recommendations, with further specifications under each recommendation (Figure 1).

Figure 1: The Engineers Australia Code of Ethics

It clearly states that engineers need to act with integrity, practice competently, uphold the reputation of the engineering profession, and serve the community to foster health and wellbeing. It doesn’t tell engineers, however, how to handle ethical dilemmas when they present themselves. This is the realm of Engineering Ethics Teaching practices that primarily focus on reasoning through ethical dilemmas to achieve sound moral judgments (Magun-Jackson, 2004; Hamad, Hasanain, Abdulwahed & Al-Ammari, 2013; Baligar & Joshi, 2017).

Traditionally, when teaching ethics is part of the engineering curriculum, students are given a fictional or real case study (for example the VW case), discuss the different possible ethical judgments related to the case study, and justify their judgments in terms of existing ethical theories (Hersh, 2015). Depending on the teaching practice undertaken, some students would be encouraged to engage in an exercise of perspective taking and metacognition, which was shown to positively promote students’ moral reasoning and judgment capabilities (Hess et al., 2017; Hess et al., 2019).

Students' moral reasoning is traditionally framed around Kohlberg's cognitive stages of moral development (CMD) (Table 1) (Kohlberg & Hersh, 1977). The most common tool for assessing moral judgement is the Defining Issues Test (DIT) and is based on Kohlberg's CMD (Bebeau, 2002). Engineering and Science Issues Test (ESIT) for Ethics instruction was more recently developed specifically in the context of engineering practice (Borenstein, Drake, Kirkman, & Swann, 2010; Kerr, Brummel, Daily, 2016).

Table 1: Kohlberg Stages of Development (Kohlberg & Hersh, 1977)

Level1: Preconventional	Stage1	*Punishment and Obedience Orientation* This stage involves total obedience to power figures and avoidance of punishment.
	Stage2	*Instrumental-Relativist Orientation* This stage is based on satisfying one's own needs. Reciprocity is in terms of "I'll help you if you help me".
Level2: Conventional	Stage3	*Interpersonal Concordance Orientation* This stage is around pleasing others and seeking approval by being "nice"
	Stage4	*"Law and Order" Orientation* This stage involves respecting authority, following rules, maintaining social order and doing one's duty
Level3: Postconventional	Stage5	*Social Contract, Legalistic Orientation* This stage aims for social utilitarianism, where individual rights are approved by society as a whole.
	Stage6	*Universal-Ethical-Principle Orientation* In this stage, there are no predefined rules. Right is defined according to one's own ethical principles.

Unfortunately, while the DIT and other measures are good predictors of moral judgment, they only account for 20% of moral behaviour (Hannah, Avolio & May, 2011). This means that while individuals may make good moral judgements, their actions may not follow. For example, the VW engineers may have come to a moral judgement that the "defeat devices" were unethical, but they still implemented the software that allowed for extensive release of nitrous oxide.

This paper addresses the limitation of existing engineering ethics teaching practices by making recommendations to turn moral judgment into moral action. The recommendations are supported by a widely accepted ethical decision-making model; they highlight important aspects of the model that are currently not incorporated in the teaching of engineering practice, namely the situational context and the individuals' moral capacity to go beyond judgment and into action.

Models of Ethical Decision Making

Engineering professional practice involves continuous engagement in judgement and decision making. Figure 2 depicts the life cycle of an engineering project from conception to operation (CDIO framework). The process of judgement involves critically evaluating alternatives based on available information, while decisions involve selecting preferred options from alternatives. Judgements and decisions tend to rely of executive functions for planning and control, as well enabling cognitive capabilities such as working and long-term memory, attention, and existing schemas from prior experiences.

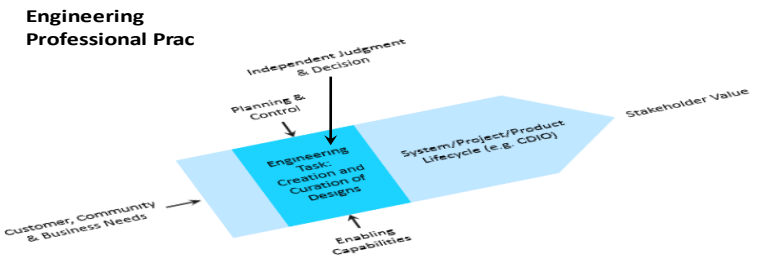

Figure 2: Concept of Engineering Professional Practice

Most of the time, engineers engage in judgement and decision processes that do not involve a moral issue. Sometimes, however, engineers will face a situation affecting the interest and welfare of the community they are serving in a way that conflicts with their personal, organisational or societal moral standards (Schwartz, 2016). These engineers will then engage in Ethical Decision Making (EDM).

Several models of EDM have been proposed in the literature, all serving various professions. They generally fall into two broad categories, 1- Reason-based models which assume that judgement and decisions follow a moral reasoning process (Kohlberg, 1973; Rest, 1986) and 2-Intuition and Affect based models which assume that both intuition (a cognitive process) and emotion drive ethical judgements while moral reasoning play a secondary role (Haidt, 2001). This paper will focus on a recent EDM model which incorporates both cognition and affect, the Integrated Ethical Decision Making (I-EDM) model (Schwartz, 2016) depicted in Figure 3.

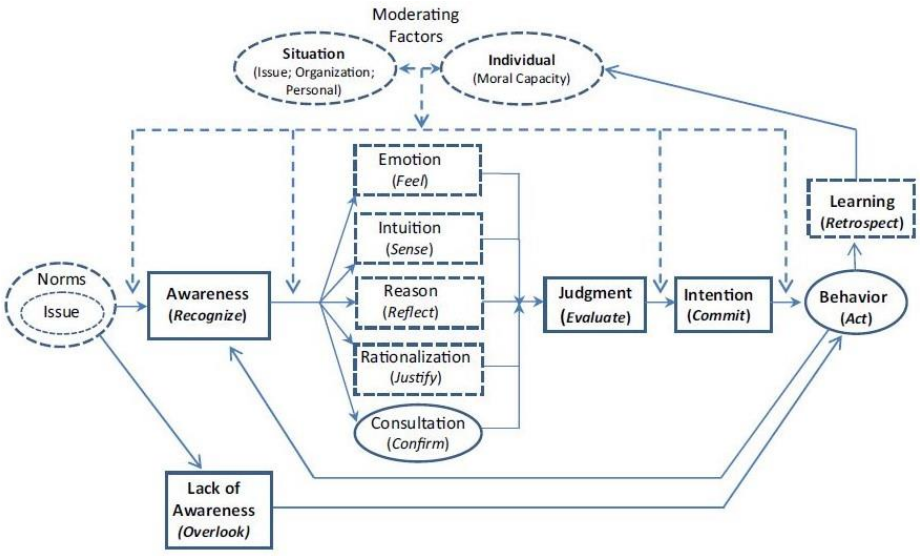

Figure 3: The Integrated Ethical Decision Model (I-EDM) (Schwartz, 2016)

The model's starting point is "The Issue". This is where conflicting norms and values first appear, creating a dilemma that needs to be resolved. Norms refer to "prevailing standards or expectations held by a particular group or community" (Schwartz, 2016). Engineers may have different sets of values from that of the organisation where they work or from the society where they live. They may be working for an organisation where engineering processes do not need to be strictly followed or living in a culture where bribes are the norm.

The model allows for the possibility of lack of awareness of the issue, in which case no dilemma arises, but engineers are unaware of their unethical judgement and decision making. Lack of awareness depends on the individual's *moral sensitivity* (Reynolds, 2008). It has also been attributed to a process of self-deception (often unconscious) that is exacerbated when the organisation tends to prioritise profits over ethical considerations (Reynolds, 2008). The I-EDM model also has a feedback loop at the end of its processes, allowing for an opportunity to learn, for example if the ethical issue that was once ignored is amplified to a level where it can no longer be ignored.

Assuming individuals are now aware of the moral dilemma of a given situation, they engage in cognitive and affective processes that lead to a judgment, decision, then behaviour. Ethical decision making involves choosing from a set of possible outcomes, and generally, no outcome is entirely satisfactory (Mattison, 2000).

Moral reasoning (reason) involves reflecting and weighing various alternatives using ethical criteria as support. For example, fairness and consequences of various decisions could be compared, and the comparison would lead to an optimal ethical decision. This is the area of focus of most engineering teaching practices. Beyond reason, emotions are also often involved and can strongly affect moral reasoning. For example, in the presence of fear, the brain's executive functions and therefore moral reasoning tend to be bypassed. Engineering ethics studies are starting to consider emotions as playing an important role in ethical reasoning and moral judgment (Sunderland, Ahn, Carson, & Kastenberg, 2013). Intuition refers to a cognitive process that is automatic and that leads to an initial "gut sense" and generally precedes more reasoning (Haidt, 2001). It may be based on existing experience. The model also allows for consultation, for example with peers, to support their decision making. Moral consultation may or may not lead to better ethical outcomes. Importantly, the model allows for judgements and decisions to be moderated by individual and situation characteristics.

Individual characteristics relate to the individual's *moral capacity* to judge, decide and act when morally conflicted. Moral capacity is a combination of their *moral character disposition* as captured, for example, through Kohlberg's Cognitive stages of Moral Development (Table 1), and their *integrity capacity*, that is their ability to uphold their ethical behaviour in the face of adversity (Hannah et al., 2011). Individual moral capacity is influenced by demographics (gender, age, education level, …), personality, as well ethical training and experience (Schwartz, 2016).

Situational characteristics comprise 1) the issue that is at the source of the ethical dilemma, 2) the organisation, and 3) personal factors at the time of the ethical dilemma not related to moral capacity.

The issue needs to have a high enough *moral intensity* and *importance* to raise the engineer's awareness. As mentioned earlier, there is an element of subjectivity depending on the *moral sensitivity* of the engineer. Issue *complexity* is another important element that could prevent an engineer to engage with an ethical dilemma. The VW case is an example of a complex issue where whistleblowing on the organisation's unethical behaviour can be perceived as a complex decision with difficult consequences for multiple stakeholders (Schwartz, 2016).

The organisation, in particular its ethical infrastructure can play an important role in moral judgment and decision making. Ethical infrastructure refers to ''…the organizational elements that contribute to an organization's ethical effectiveness'' (Tenbrunsel et al., 2003), and forms part of the organisation's governance. This topic will be addressed in further details in the following section

Finally, individuals' personal situation at the time of the ethical dilemma, regardless of their moral capacity, can also affect their ethical decision-making process. Are they facing personal issues at home or in the workplace? Are they in a weak financial situation? These personal issues, regardless of individuals' moral capacity, carry an emotional load which could alter the

judgement and decision process towards unethical outcomes, particularly if there is a perception of gain (Schwartz, 2016).

Recommendations for improving the teaching of Engineering Ethics

An important shortfall of existing teaching practice is that they focus on a small portion of the I-EDM model (Figure 4), that is “moral reasoning leading to moral judgement”.

Figure 4: Current practices focus on this small portion of the full I-EDM model (Figure 3)

As mentioned earlier, more often than not, moral judgment does not always lead to moral behaviour. In other words, the portion of the I-EDM model shown in Figure 6 below is not, to the best of our knowledge, addressed by current engineering teaching practices.

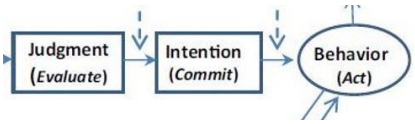

Figure 6: Current teaching practices do not address how judgment translates to behaviour

This incongruence between moral judgement and moral behaviour is addressed by considering two important factors, depicted as moderators in the I-EDM model, 1) the *situational context*, and 2) the individuals’ *moral capacity* to uphold ethical judgements (Figure 5). This section makes recommendations around incorporating these 2 factors into engineering teaching practices.

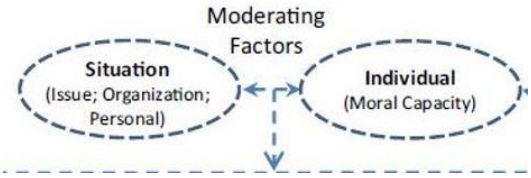

Figure 5: Teaching practices need to incorporate this portion of the I-EDM model (Figure 3)

The following psychological experiment illustrates the importance of these two concepts.

Milgram’s experiment (McLeod, 2007). Stanley Milgram was a professor of psychology at Yale University, and the son of Jewish immigrants. Following the Nuremberg trials where the main defence for holocaust crimes was that nazi officers were just following orders, Milgram decided to investigate the extent everyday citizens were willing to hurt others just because they received an order from a higher authority. The experiment Milgram designed involved a teacher, a learner, and a researcher. The teacher was a participant unaware of the real intent of the experiment. Participants were told that the purpose of the experiment was to investigate the extent punishment would improve learning, and punishment consisted of administering electroshock of increased voltage intensity (up to 450V) every time the learner made a mistake. The learner was an actor strapped in electrodes and was pretending to be hurt when electroshocks were administered by the participants. Participants were deceived in believing they were administering actual electroshocks, and the learner (the actor) would scream and pretend to be hurt to the point of heart failure. The researcher, who was part of Milgram’s team, dressed in a lab coat, represented authority and was the one giving the order to administer higher and higher voltage shocks. All the participants continued to obey orders and administer electroshocks up to 300V. Two-thirds of the participants continued to the highest voltage value of 450V where the actor would pretend to collapse. The experiment (later deemed highly

unethical) showed that ordinary people, while highly conflicted, would still obey orders even if it involves hurting an innocent person to the point of collapse.

This is an example of how the situational context, in this case the researcher's authority, and individuals' moral capacity could impact ethical judgment. The participants' moral judgment probably dictated that they should not hurt the learner, but their capacity to act in alignment with their judgement was jeopardised by the authority of the researcher. The organisation can represent authority, and as in the VW case could put pressure on engineers to undertake unethical actions that could potentially have harmful consequences to the community. Should the VW engineers object to the directive of falsifying emission reports and as a result betray their organisation, their work colleagues, and their ability to support their family through potentially losing their jobs? In this context, the engineers are weighing individual values against organisational and societal values and pressures, and the answers are not easy.

Interestingly, in the Milgram experiment, when participants went back home and talked to their partners about the experiment and the choices they made, all partners stated that they would not have obeyed orders. This last point demonstrates how, when the situational context is removed, people may believe their behaviours would be aligned with their judgment, which is not necessarily true and heavily depends on their moral capacity in a given situation. Similarly, when engineering students make a moral judgement unaware of the situational context (in particular the organisation), they are unable to reflect on their moral capacity.

Recommendation 1

The situational context (Organisation)

Over-reliance on individual moral reasoning without situational context has already raised a number of concerns when it comes to teaching engineering ethics (Zhu & Jesiek, 2017; Lawlor, 2021). As mentioned above, individuals outside the organisational context tend to believe that their moral judgments and actions will be aligned. In context, judgements, intentions or decisions and behaviours may not be congruent. The organisation culture may affect individuals' capacity to take action on their moral judgement. This first recommendation is to bring the organisation into the case study presented to the students. This will raise their awareness around corporate governance and its importance in ethical decision making.

Corporate governance sets the organisation's goals, direction, limits, policies, structures and accountability frameworks, which together provide the principles for organisational decision making. Through these means, governance shapes the corporate culture and values, including a moral compass that influences employees' ethical behaviour. This is consistent with prevalent ethical decision models that suggest that individuals make decisions based on personal aspects, group variables, environment factors and situational aspects, such as severity of the consequences, rewards or punishments (Craft, 2013). Previous research highlights the importance of awareness of the corporate culture and values, seen as the personality of the organisation, to guide employees ethical decision making (Knouse, Stephen & Giacalone, Robert. 1992) and the integral role of ethical accountability in the organisational culture (Potts, & Matuszewski, 2004).

An enterprise will define an Engineering Management System (EMS) as a subset of its corporate Quality Management System (QMS). The EMS outlines the principles, processes and procedures by which the engineering organisation will achieve management and technical control over its engineering operations. Corporate guidance on social responsibility (regulatory compliance, safety and environment, etc) will be flowed down to the EMS. In a large enterprise the EMS may comprise many hundreds of artefacts. A large project or program within an enterprise may develop its own management system, often called an Engineering Management Plan, tailored to its specific needs, using the enterprise EMS as its basis. With this approach, guidance on social responsibility will be flowed down from the enterprise level to the operational level; its effectiveness at that level will be dependent on operational managers.

The purpose of the EMS is to achieve proper control, coordination, consistency and standard of engineering services. A properly implemented EMS will ensure that no individual engineer can operate in isolation of these control and coordination processes. Error reduction and risk management processes are integral to the EMS and are implemented through extensive independent review of designs at specified gates, as well as through independent review and approval at the level of engineering documents. With careful implementation, potential ethical failures which present as errors or risks can be detected by these EMS processes.

Recommendation 2

Moral Capacity

As mentioned in the introduction, the most common tool for assessing moral judgement and decision making is the Defining Issues Test (DIT) (Bebeau, 2002), even though in was reported to account for only 20% of the variance in ethical behaviour. The main reason is that moral judgement is not always carried through to action, often because of the situational context (Bebeau, 2002). The ability to act on a moral judgement is referred to as *moral conation capacity* and consists of three components, *moral ownership*, *moral efficacy* and *moral courage.* For individuals to carry through a moral judgement into moral action, they need to take responsibility (moral ownership), feel they have the capacity to take action (moral efficacy), they find the courage to carry through (moral courage) (Hannah et al., 2011).

Moral ownership involves some sense of responsibility over the decision and action that needs to be undertaken. If the authority exerted by an organisation is such that individuals feel that they have no choice but to obey orders, they will have little moral ownership regardless of their moral judgement.

Moral efficacy refers to the individual's perceived capacity, capability, and available resources to act following judgment. It depends on both the situational context and the perceived magnitude of the task ahead

Moral courage has been identified as critical in taking action against perceived and actual barriers and threats within organisations. Even when individuals feel a sense of ownership and feel that they have the capability and resources to act, they may lack the courage and strength to follow through with their judgment (Hannah et al., 2011).

It is therefore important when teaching ethics to future engineers, to not only focus on developing students' moral reasoning, leading to ethical judgment making, but to also invite them to reflect on their moral capacity to take action on their judgment by investigating their sense of ownership, efficacy and courage in a given situation.

Conclusion

This paper offered recommendations to supplement existing teaching practices of engineering ethics as described in the literature, by considering two moderators of ethical decision making, the situational context and individuals' moral capacity to carry a judgement into action. The two moderators are components of a widely used ethical decision-making model and, to the best of the authors' knowledge, are not currently considered in existing teaching practices.

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