

Homines Oeconomici or Moral Saints? On the Purpose of Educating Civil Engineers

Jardar Lohne

(jardar.lohne@ntnu.no)

Frode Drevland

(frode.drevland@ntnu.no)

Tina Åsgård

(tina.asgard@hvl.no)

Tore Hoven

(tore.hoven@ntnu.no)

Ola Lædre

(ola.laendre@ntnu.no)

Department of Civil and Environmental Engineering, NTNU

Truls Ryum

(truls.ryum@ntnu.no)

Department of Psychology, NTNU

Abstract

Understanding one's own role as a professional – and the role of one's profession – within society at large is crucial for good conduct and practice. The ambition of this paper is to address 1) how we can envisage how to develop the reflexive capacity of students of Civil Engineering to undertake critical scrutiny of their own practice and, 2) to what extent are Norwegian civil engineering students are educated to incarnate such a reflexive capacity today. The main basis of the research consists in a content analysis of the formalized guidelines governing the education of Civil Engineers at the Norwegian University of Science and Technology (NTNU). In addition to a scoping literature review, insights from theory on what constitutes a profession and the role of professions in general were used as analytic tools. The findings indicate that limited attention is given to transmitting the understanding of the role the students are to fill in their professional lives. Even less attention is given to actually articulating such an understanding. Particularly interesting, however, is the limited attention given to considerations of a more principal nature concerning the ability to transcend (in a positive manner) the limits within which one normally operates. The research carried out has implications for the organisation of the education of Civil Engineers in general. Equally, it highlights concerns that professional bodies within the field ought to examine in order to carve out a thorough understanding of the role of the Civil Engineer in society today.

Keywords: content analysis, engineering ethics, construction industry engineers, education

1. Introduction

In *Fraggle Rock* (a children's puppet television series created by Jim Henson), three anthropomorphic species form most of the action: Fraggles, Doozers and Gorgs. The Fraggles and Doozers live in a system of natural caves called *Fraggle Rock*. Outside *Fraggle Rock* lives a small family of Gorgs, farmers with a rustic house and corresponding garden patch. Fraggles are considered pests by the Gorgs, as they often steal radishes from the garden of the latter.

Fraggles live a generally carefree life, spending most of their time (having a thirty-minute workweek) enjoying themselves. They live on radishes and the material the Doozers construct. Not surprisingly, these colourful nonconformists constitute the main attraction of the series. Doozers – small, industrious beings – are in a sense anti-Fraggles; their lives are dedicated to work and industry. Doozers spend their time busily constructing throughout *Fraggle Rock*, with an edible material greatly enjoyed by Fraggles.

In episode 6 of the first season (February 14th, 1983), this order of society is threatened. One of the main *Fraggle* characters, Mokey, decides that on moral grounds it is not proper for Fraggles to eat the constructions the Doozers work so hard to build. Disgruntling, the others Fraggles accept this, with hunger and discontent amongst them as a result. The consequence of this policy being enacted is predictable. With *Fraggle Rock* being limited in space, and both supply of construction materials and the endeavour of the Doozers being limitless, the space available for construction is soon occupied.

The interesting part here concerns in effect the Doozers. Whilst the Fraggles live as artists and small-time pinches, parasitic if charming idlers and dreamers, the Doozers resemble to a large degree professionals of the AEC-industry, incarnating high levels of production output and lean construction capabilities. When their manner of existence – that is, constructing continuously – is put under strain, however, they are paralysed. How can we understand this?

One striking characteristic of the Doozers is the *automaticity* of their work. It is not that they do not carry out formidable work – anyone having seen the TV-series will remember astonishing bridges and other constructions defying the law of gravity. Neither does there seem to be anything blameworthy in their work procedures. The Doozers are highly competent, efficient and with a strong focus on HSE-aspects of their work. Still, this does not seem to suffice when put under strain by radically altered framework conditions. In other words, they lack the capacity to transcend the limits of their habitual manners and ways of work.

The idea we pursue in this paper is that what the Doozers actually seem to lack is a proper sense of their function within society that surpasses the idea of solely constructing, and that it is this lack of understanding that render them vulnerable to the consequences of Mokey's new policy. They are, so to speak, "doers" without a reflexive capacity (that is, a capacity for meta-cognition wherein their own manners of action are judged) sufficient to assess the higher-order (that is, moral in a broad understanding, including norms, values and unspoken rules of behaviour) sense of their activity and therefore unable to tackle the new situation they are left in. The example of the Doozers is evidently caricaturised *ad absurdum*; still, it resonates with strings observable in the community of professionals of the AEC-industry. What more is, it seems to resonate with how civil engineering students are educated within the Norwegian context today.

Whilst their ability for construction is strong, the reflexive interrogation on the reasons for one's activity (based on the impression of the authors) seems in fact to be scarce among students – as is the case with the Doozers. They are (educated to be) builders; therefore they build. It is the opinion of the authors of this paper that a university ought to guide its students towards an understanding of higher-order sense of their professional role – that is, moving from being purely technicians to being conscious members of a profession with certain inherent ethical standards. How and in what form this happens today is, however, far from evident and little investigated. Consequently, the research questions we address in this paper are:

- Of what nature can we envisage the higher-order sense (that is, moral in a broad understanding) that enable students to surpass the state of Doozers-to-be?
- How is the need for understanding this higher-order sense reflected in official university documents outlining the goal of engineering education?

First, we outline two extreme (yet quite common) figures of thought that can be envisaged as constituting a possible framework for such an analysis of higher-order purposes. These figures of thought are both taken from the field of ethics, notably the “homo oeconomicus” and the “moral saints”. Further, we explain why none of these figures of moral thought in the larger sense seem adequate as guiding principles, and outline why insights from virtue theory better can serve. Finally, we propose to show the limits of an explicit purpose for the education of the students (and outline a reason thereof) as it appears from the governing papers of the NTNU (Norwegian University of Science and Technology). The NTNU is by far the most significant actor in educating Masters in Civil Engineering in Norway, as approximately 80-90% of all MSc-students within this field are from this university, thus making the NTNU the very cornerstone of the professional ethos of the profession.

2. Research Methods

The methodological approach of the research behind this paper was twofold in nature. First, a scoping literature study of general literature was carried out in accordance with the procedures described by Blumberg et al. (2011) and Arksey and O'Malley (2005). Secondly, a content analysis of the university's formulation of outputs, goals and purposes for the education of civil engineers at NTNU was carried out according to the procedures outlined in Krippendorff (2013). The overall ambition of the methodological approach has thus been to elucidate the formal (written) guidelines governing the education of MSc-students within the institution.

3. Theoretical Framework

In the literature, the state of the Doozers is typically described as so-called moral blindness. By this is understood a state of unawareness or insensibility to moral issues pertaining both to oneself and to one's relations to others (Bauman and Donskis, 2013). The utter lack of understanding of the why's of their actions – being essentially occupied with the how – indicates that the Doozers are unconscious of their function within a larger whole. The question of understanding one's function within a larger whole is fundamentally of an ethical nature, since it implies a demand to understanding how to behave in society.

Understanding the why of one's actions is, in fact, crucial to attain what Mirsky et al. (2014) maintain as the most important topic to the future of the AEC industry, notably "honourable, professional practice" (Mirsky et al., 2014:vi). Recent years have witnessed an increasing interest in the field of applied ethics in general and in professional ethics in particular (Christoffersen, 2010). Different professions establish rules and regulations, and the number of publications is ever increasing. The authors of this paper have so far not seen this trend reflected strongly in publications concerning the AEC industry in general and engineering students in particular. As Walker (2014) comments, "[t]here is a dearth of papers related to ethics in PM even though the PM discipline should maintain a strong and enduring interest in ethics to encourage project managers to deliver value in a more holistically manner that is consistent with being a member of a profession". This (ethical) understanding of being a member of a profession of the AEC-industry ought particularly to be felt by engineers. According to the literature review leading up to the research presented here, codes of conduct (ethical frameworks) do in fact exist (amongst which from the PMI, RIBA, AIA, ASCE and IPMA); such codes of conduct are, however, typically general in nature, and tend not to take practical moral challenges into concern. This is particularly grave, considering that, as Bredillet (2014:548) comments, "the underlying ethical approaches supporting the field, and consequently the practice, have immense impact". Notable exceptions from this general statement include the writings of Bowen et al. (2007); Bröchner (2009); Collier (2005); Corvellec et al. (2010); Fellows et al. (2004); Hill et al. (2013); Ray et al. (1999); Bredillet (2014); Walker (2014); Lloyd-Walker (2014); Kvalnes (2014); Lohne et al. (2017). The general picture of a lack of interest must, however, be said to still be intact. Based on this sombre analysis, we maintain that the framework for education of the ethos (from an ethical perspective) of the students is weak.

Several models could serve as examples for such an ethos. In the following, we explore the principles on which an engineer ought to base his action in society on via two figures of thought, notably those of the homo oeconomicus and of the moral saint.

3.1 Homo Oeconomicus

Proponents of the idea of the homo oeconomicus typically portray humans as consistently selfinterested agents who pursue their ends optimally. The homo oeconomicus consequently attempts to maximize utility out of self-interest. He is thus rational in seeking to optimise utility given perceived opportunities. One famous fictional character incarnating this idea is Gordon Gekko in the movie picture "Wall street" (1987), with his publicly expressed motto "greed is good". Not surprisingly, the model of the homo oeconomicus has received severe criticism for being unrealistic, that is, not corresponding to actual human behaviour. On psychological grounds, already studies of Tversky and Wakker (1995) followed by Tversky and Fox (1995) questioned the assumption that investors – typically taken to be the utmost proponents of economic rationality – are actually acting according to this idea of rationality. Both studies demonstrate the tendency of these to make risk-averse choices in gains, and risk-seeking choices in losses. This violates the idea of economic rationality outlined above. The homo oeconomicus has equally been criticized for being conceived as an actor with too great an understanding of forecasting in decision-making. The importance of uncertainty and bounded rationality has thus been highlighted in the analysis of economic decisions (for a philosophical argument concerning the boundaries of human rationality, see Gadamer (1960)); typically, addressing such factors rather than relying on the rational man who is fully informed of all circumstances

impinging on his decisions are found to be crucial. Proponents of such criticism maintain that perfect knowledge never exist, which means that all economic activity implies risk.

Beyond arguing that the model is unrealistic, the major question within this context concerns whether we really wish to promote *homines oeconomici* to fill professional functions as civil engineers and the like. On personal grounds, it might seem of little attraction to have co-workers sworn to egoistic optimisation of personal goals at all times. Likewise, in a collective of professionals, such individuals must necessarily be considered to contribute little to common priorities. There does in fact seem to be little reason for the *homines oeconomici* to involve in the “honourable, professional practice” sought after by Mirsky et al. (2014). Beyond the question of general dislike, critics of the *homo economicus*, (e.g. Frey, 1997), point to the excessive emphasis on extrinsic motivation (rewards and punishments from the social environment) as opposed to intrinsic motivation. The main point is that too much emphasis on rewards and punishments can discourage intrinsic motivation: paying children for doing household tasks may push them from doing those tasks “to help the family” to doing them for the reward. Within the perspective of the AEC-industry, it is difficult to understand why *homines oeconomici* would involve in work for the benefit of an entire profession. The question of the resilience of the *homo economicus* to radically altered framework conditions – or perceived opportunities – can be understood in this light. Given the propensity to act on extrinsic incentives of the *homo economicus*, radically altered framework conditions – that is, radically altered extrinsic incentives – will provoke radically altered patterns of conduct.

Katz (2011) outlines a thought-provoking example of this fragility in an essay describing how engineers, architects and other technological professionals of the AEC-industry designed the genocidal death machines of the Third Reich. As he underlines, the death camp operations were highly efficient, so these technological professionals knew what they were doing: they were, so to speak, good engineers. Beyond that many of these engineers were convinced Nazi-adherents, the fact remains that many simply acted according to the altered extrinsic incentive structure of the Third Reich. Without proper intrinsic resilience, the pressure to accept new extrinsic incentive structures can prove insurmountable.

In sum: The *homo oeconomicus* pledges enlightened self-interest as the sole basis for rational decision-making. Apart the psychological improbabilities, this renders him both oblivious to the larger professional body, and fragile towards altering external incentive structures. Thus, the *homo oeconomicus* appears as a little desirable purpose or which to educate civil engineer students. At the entire opposition of the *homo oeconomicus* can be found what Susan Wolf has named “moral saints”, loving and compassionate beings, filled with the utmost love for others.

3.2 The Moral Saint

The characteristics of the moral saints Wolf outlines in her eponymous essay are extreme in nature by their self-sacrificing nature. By *moral saint*, Wolf understands “a person who’s every action is as morally good as possible” (1997:79); thus, the moral saint is a figure of thought incarnating pure altruism as opposed to the pure egoism of the *homo oeconomicus*.

A moral saint consequently must “have and cultivate those qualities which are apt to allow him to treat others as justly and kindly as possible. He will have the standard moral virtues to a nonstandard degree.

He will be patient, considerate, even-tempered, hospitable, charitable in thought as well as in deed. He will be very reluctant to make negative judgements of other people. He will be “careful not to favour some people over others on the basis of properties that they could not help but have” (1997:81). We are truly facing a saintly figure, with undeniably laudable characteristics. Whether these characteristics can serve as the foundation of the education of civil engineer students is, however, not evident.

When Wolf maintains that a “moral saint will have to be very, very nice”, not having interest motivated by other things than the welfare of others, in sum, a “dull-witted or humourless or bland” figure. At first glance, this proves not to be a fundamental problem within the context of AEC-industry professionals. A society can well live with dull engineers. This is not, however, the main point of the argument. The *crux* is, in fact, that there “seems to be a limit to how much morality we can stand” (p. 83). Engineers *solely* occupied by the well-being of others will for instance in general prove highly inadequate in business. Creating and reaping the benefits from creating seems necessarily to imply concerns of self-interest of some sort.

Wolf points, in effect, to a perspective “generally ignored” by contemporary moral philosophy, notably that “a person might be perfectly wonderful without being perfectly moral” (p. 95), referring to comedians with an edgy tone, musicians playing for their own benefit, philatelist enjoying solitude etc. If we rephrase this in light of professionals of the AEC-industry, it seems more likely that they are good professionals if not their sole focus is being perfectly moral. This insight seems in fact to be captured by actors within the industry. For instance, none of the ethical frameworks examined in Lohne et al. (2016) professed anything like moral sainthood as a purpose for which to strive.

3.3 Virtue Ethics

Virtue-based ethics takes a different stance to the question of judging what is estimable than the purity (of self-interest or altruism) observed in the two figures of thought discussed before. Rather than focussing on abstract principles from which rules of conduct can be determined, virtue ethics in the tradition from Aristotle and his Nicomachean ethics (~ BC 400) focuses on what it calls the character of the actor. The question haunting fourth century BC Athens – how can one assure that citizens act in an ethically sound manner – in fact resonates deeply with today’s societies in general – and the professions that form the AEC-industry in particular. This character is typically sought developed using examples, exposing the ethically good and blameworthy behaviour.

If, then, we are to educate students to not only satisfy project delivery objectives and user requirements (goals), but also being capable of fulfilling and identifying higher-level objectives (purpose) of their practice, the question imposes itself: what are, in effect, these higher-level objectives? In what do they consist, and how are they to be transmitted? The question of the purpose to which the students are being educated can be posed in light of the roles they are to undertake. At first glance, to outline the role of the professionals-to-be does not seem so complicated. The preponderant role of the NTNU within the industry assures that a large number of the students go out to fill senior and leading positions. In addition to the production-oriented leadership (project managing, design managing etc.), former students of this institution constitute the core strategic leadership of most organisations within the Norwegian AEC-industry.

Most private sector organisations are characterised by a strong professional awareness, and both operational and strategic leadership functions are filled by civil engineers. In public organisations, the picture is somewhat more mitigated (other professions tend to blend into the strategic level) but the general impression remains – civil engineers dominate the industry at all levels, from workplace operations to strategic decision making.

Such a general mapping of what roles the students are educated to fill does not, however, provide us with sufficient tools for understanding of the higher-level objectives of their education. As was the case for the Doozers, an intuitive comprehension of own role and function is vulnerable for external pressure that dramatically challenge traditional role of the engineers.

The example of the professionals in Nazi Germany illustrates the need of engineering to be good engineers in a moral sense. Bloom (1987:26) makes this point utterly clear within the context of the educational institutions: “Every educational system has a moral goal that it tries to attain and that informs its curriculum. It wants to produce a certain kind of human being. This intention is more or less explicit, more or less a result of reflection; but even the neutral subjects, like reading and writing and arithmetic, take their place in a vision of an educated person”. If we accept that we need students with a moral vision, that this vision needs some kind of principles being established, and that the comprehension of the role which they are to fill is essential in this undertaking, a scrutiny of the role of civil engineers within the Norwegian context imposes itself.

3.4 Civil Engineers and Their Role within the Norwegian Society over the Last Century

What constitutes a profession is far from clear, and has been subject to much debate. Whether engineers constitute a profession is even more debated, leaving some to call engineering “the failed profession” because engineers are relatively unorganized and have not been able to completely monopolize their area of expertise (see for example Brante (2011) and Nygaard (2014)). Still, most scholars seem to agree that a profession is a term that applies to certain occupations held by people with specialized training based on higher education (Molander and Terum, 2008). Thus, engineering seems to fit at least the lowest common denominator, if not all of the criteria normally applied to define a profession.

Another common assumption about professions is that they possess a certain work ethic, and have a particular obligation to work for the common good (Abbott 1988, Macdonald, 1995; Molander and Terum, 2008; Brante, 2011; Slagstad, 2014). One therefore expects professionals to be guided by a code of conduct that will override narrow considerations of self-interest (utility maximization) when confronted with ethical dilemmas. It is also assumed that the professional integrity of the professional will protect him or her against possible abuses based on employer’s managerial prerogative (Slagstad, 2014). Professions are furthermore politically constructed occupations (Molander and Terum, 2008). Their jurisdiction is based on state policy that privileges people with a certain education the right to perform certain tasks on behalf of society. It can therefore be argued that professionals have a special obligation to serve the common good. It can also be argued that in an education system like the Norwegian one, where higher education is free of charge (at least in principle), the obligation towards serving the common good is greater than it would otherwise have been.

In Norway, the education of engineers started as part of the industrialization process from the middle of the 1800s (Nygaard, 2014). The efforts culminated with the establishment of NTH (The Norwegian Institute of Technology, now called NTNU) in 1910. NTH has played a key role in educating engineers in Norway ever since. From the beginning, NTH was inspired by German engineering ideals with a high emphasis on theoretical education in natural sciences. At the beginning of the 1900s, the role of the engineers as a managerial profession within the Norwegian context started to form. Engineers exercised their craft as managers both in industrial enterprises and in technical areas of the public sector. This happened despite the fact that the educational programs of the NTH did not prepare engineering students for the tasks involved in leadership and management of organizations. In the same period, engineers together with other professions took on the huge societal tasks of improving peoples living conditions in the cities, and connecting the country through new infrastructure (Skogheim, 2014).

The period following the end of WWII is sometimes called the golden age of engineers in Norway (Nygaard, 2014). After WWII, they played vital roles as industrial leaders in the efforts of rebuilding the country (both literally and figuratively speaking), and as advisors on policy issues. The post-war efforts towards further industrialization and modernization united the labour movement and the engineering profession, and put this latter literally in the lead of this joint effort towards the common good. The understanding of engineers as natural leaders took a dramatic turn in the 1960s, when studies showed that the majority of civil engineers were uninterested in administrative tasks, and that engineers were not educated (or suited) for leadership (Nygaard, 2014). In the 1970s, critique was heard against the consequences of post-war industrialism and modernization. The engineers, who had a leading role in the post-war societal development, were accused of not acknowledging negative consequences of their activity as professionals, and having a narrow-minded technology-technocratic view of their societal role (Nygaard, 2014).

Concerning the situation of how to understand the engineering profession over the last 30 years, the research literature proves rather sparse. This lack of analysis seems to pertain to both the outer (societal) role of the civil engineer and to the understanding of the inner (the ethos) role. In order to articulate how this understanding is reflected in the university's formulations of the ambitions for education of engineers, we in the following draw on insights from the Project Management literature.

4. Findings – The Education of MSc-Students at NTNU

4.1 Nature of the higher-order sense

The students should – in the opinion of the authors – come to a higher-order (profession-based ethical consciousness) sense that enables them to surpass the state of Doozers. They should come to a certain level of consciousness about their role, without getting too far in the direction of neither *Homines Oeconomici* nor moral saint. This can be illustrated in the following figure:

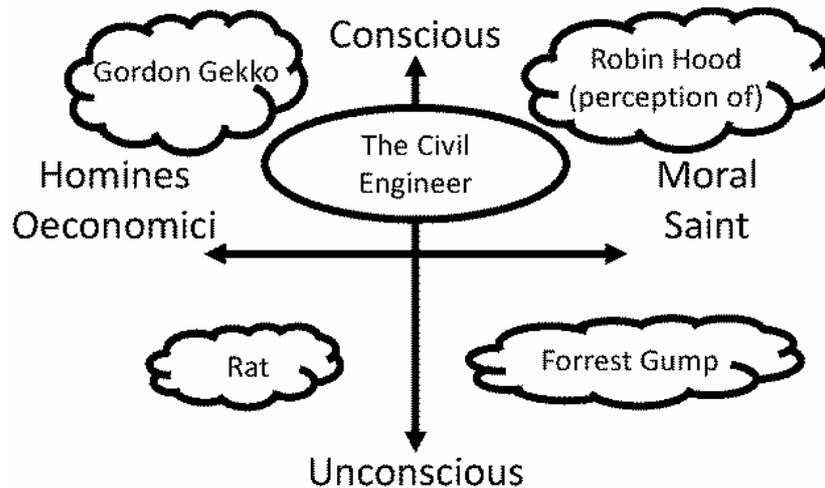


Figure 1: The nature of the Civil Engineer, illustrated by the dimensions Conscious/Unconscious and Homines Oeconomici/Moral Saints

The above figure outlines four figures of thought, fictional characters (for what concerns the rat, this fictional character is the popular representation of the rat in diverse media, not the actual rodent of unsurpassable opportunistic intelligence). As we shall see in the analysis of the formal guidelines examined, none of the four figures thus outlined correspond to the envisaged civil engineer to be. The general finding is, on the contrary, that the image of the coming engineer is highly inspired by lessons similar to those outlined in this paper under the virtue ethics heading.

4.2 To what extent do the education of MSc-students reflect the need for understanding the higher-order sense of their function

The MSc-study program at NTNU is highly compartmentalised, and characterized by a general division between the general natural science/mathematical subjects mainly thought in the first 45 semesters and the specialization courses of the following semesters (see table 1).

Accompanying this general plan of the courses provided, an overreaching outline of demands to the competencies of future civil engineers from the NTNU is provided (Table 2). In Table 2, we outline how the different demands are reflected in the course curriculum of the individual courses outlined in Table 1:

Table 1: An overview of the content of the courses provided by the Civil and Environmental Programme at NTNU

Sem-ester	7,5 Credits	7,5 Credits	7,5 Credits	7,5 Credits
10	Master's Thesis			
9	Non-Technologic course	Specialization (project + subject)		
8	Experts in Teams	Specialization course	Specialization course	Specialization course
7	Non-Technologic course	Specialization course	Specialization course	Specialization course
6	Technology Management	Specialization course	Specialization course	Specialization course
5	Calculus 4	Specialization course	Specialization course	Specialization course
4	Statistics	Fluid Mechanics	Geotechnical Engineering and Engineering Geology	BM 4 Design of Buildings and Structures
3	Calculus 3	Physics	Mechanics 2	BM 3 Transport Infrastructure
2	Calculus 2	Philosophy and Theory of Science	Mechanics 1	BM 2 Hydraulic and Environmental Eng.
1	Calculus 1	Inform. Techn. Intro.	General Chemistry	BM1 Building and Construction Materials

Table 2: Overarching demands to future civil engineers educated from the NTNU and an assessment of to which extent this is assured through the course curriculum

Knowledge	
<i>Broad basic knowledge in Mathematics, Science, Technology and Computer Science as a basis for understanding methods, applications, professional renewal and adaptations.</i>	<i>This is assured through the fundamental mathematical-scientific courses.</i>
<i>Broad engineering- and research-based knowledge in Civil and Environmental Engineering, with in depth knowledge within a more limited area connected to active research, including sufficient professional insight to make use of new research results.</i>	<i>This is assured through the obligatory courses in construction engineering.</i>
<i>Knowledge in technological management, health, safety and environment in order to manage projects and other activities within the construction area in an efficient, economical and socially beneficial way.</i>	<i>Assured through individual courses in addition to some elements of most courses. The weight lain on this over the last years meet significant organisational opposition, as being perceived as hindering skills of technical mastery. Not measured.</i>

<i>Insight in selected social science, humanistic, and other non-technical disciplines of relevance to the exercise of the engineering profession, and as a basis for developing a broad perspective on the engineering discipline's role and challenges in the society.</i>	<i>Sought assured through the courses in Philosophy and Theory of Science, and the course "Experts in team". In addition, two complementary courses are required for all – but in these courses, this content is included quite randomly. Both intention and possibility exist. Not measured.</i>
Skills	
<i>Define, model and break down complex engineering problems, including choosing relevant models and methods, and carrying out calculations and solutions independently and critically</i>	<i>The construction engineering courses form the basis for this, whilst critical distance is actively sought assured through the MSc.-thesis.</i>
<i>Develop comprehensive solutions to engineering problems, including the ability to develop solutions in an inter-disciplinary context, and carry out an independent, particular engineering research and development project under academic supervision</i>	<i>Sought assured through the project- and master theses, in addition to experts in team (first part of the sentence).</i>
<i>Be able to work with modern Civil and Environmental Engineering methods and tools.</i>	<i>Covered partly in all different construction engineering courses. Main reason for introduction was assuring BIM in the education.</i>
<i>Be able to renew and adapt professionally, including develop professional competence on his/her own initiative</i>	<i>Not measured – is not followed up in a structural manner through the course plan</i>
General Competence	
<i>Understand the role of engineer in a comprehensive societal perspective, have insight in ethical requirements and consideration of sustainable development, and be able to analyse ethical problems connected to engineering work, and contribute to innovation and entrepreneurship</i>	<i>Understanding the role of the engineer not assured – random and dependent on choice of courses – not measured. Ethical requirements not assured – not measured. Sustainability concerns are included in several courses, both from technical and management perspectives. Analysis of ethical challenges not systematised – not measured.</i>
<i>Ability to disseminate, communicate and cooperate inter-disciplinary on engineering problems and solutions to specialists and the general public</i>	<i>The ability to cross-disciplinary cooperation is sought assured through experts in team, whilst the dissemination of results is sought addressed in the master thesis. No systematic follow-up, not measured.</i>
<i>Understand possibilities and limitations when using information and communication technology, including juridical and societal aspects</i>	<i>No systematic follow-up, not measured</i>
<i>Ability to lead and motivate co-workers, including having an international perspective on his/her profession, and develop ability to international orientation and collaboration</i>	<i>No systematic follow-up, not measured</i>

In sum: whilst the descriptions of the outputs and goals of the education of civil engineers is rather clear (improvements might evidently always be envisaged), the purpose for which the endeavour takes place remains vague.

5. Homines oeconomici or moral saints?

In the introduction, we outlined the ambition of this paper as being to address 1) how we can envisage how to develop the reflexive capacity of students of Civil Engineering to undertake critical scrutiny of their own practice and, 2) to what extent are Norwegian civil engineering students are educated to incarnate such a reflexive capacity today.

The findings presented above indicate that the Doozer-capacities (such as purely analytical/mathematical skills and even to a certain degree basic management and leadership techniques) of the MSc-students are well taken care of. On graduation, they are highly skilled in the natural science/mathematical disciplines, and are quite well skilled to take on the concrete tasks in the work positions they are destined to fill (typically as project managers, technical experts, consultants etc.). The higher-order goals (understood as their ability to reflect on their own practice), however, are less well taken care of, often being subjected to the whims and ethos of individual teachers and rarely measured. It seems, in effect, as if the overarching demands to the education are recognized – but that the practical follow-up in the education is much left to chance. It would seem that this renders the MSc-students fragile to logics of economic sub-optimisation etc. when they meet the working life of the construction industry; that is, becoming pure homo oeconomici, focussing solely on maximising own profit.

As pointed out by humanistic-existential psychology, man is not born with a predefined set of qualities or a moral codex – he simply is (Ryum, 2015). Both personal and professional development unfold in a reciprocal interaction with the social environment, which may nourish or hamper the growth of a positive identity, reflexive capacity and professional integrity (Ryan and Deci, 2000; Ryum et al., 2014). The development of the sought-after character strengths and virtues deemed imperative within a profession, such as humanity, justice and transcendence (Peterson and Seligman, 2004), needs to be cherished by educational institutions as important learning goals.

As described in the theoretical framework chapter, engineering is often referred to as the “failed profession”. Approximately 80-90 % of all Norwegian MSc-students in the field of Civil Engineering come from NTNU. The above results do not promise well for their future selfunderstanding as a profession. To verify the results, further studies are needed, especially aiming to examine the education of the large number of BSc-students of Civil Engineering that also typically fill roles as project managers, consultants etc. within the Norwegian AEC industry.

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