Doing environmental concerns in consulting engineering

Introduction

Consulting engineers constitute a profession that through their work engage with important and wide-ranging environmental issues related to, for example, physical planning, construction of buildings, transport, and water management. They are independent contractors retained to work on a project-by-project basis, and their main expertise resides in technology and architecture. Consulting engineering companies play a key role in the ongoing shaping and reshaping of the physical qualities of nature and culture, of landscapes and the built environment. Thus, potentially, they have a key role in making modern societies more sustainable. To what extent do they take on such responsibilities and what may make them engage with environmental issues? This paper tries to answer such questions through a study of how environmental concerns are enacted and dealt with by consulting engineering companies in Norway.

There are factors suggesting that consulting engineers will be very much concerned with environmental issues in their work. First of all, there is, after all, a high degree of awareness of the need to consider green designs, particularly at a time where climate change is on the agenda in most societies, and where there is considerable political pressure to promote sustainable development. Also, consulting engineers are assumed to be subjected to norms about ethics, usually articulated through professional societies .[1]

In Norway, most consulting engineering companies are members of the Association of Consulting Engineers, RIF. This is the organization for approved consulting companies in Norway, and the Norwegian member association of the International Federation of Consulting Engineers (FIDIC). Both RIF and FIDIC emphasize that consulting engineers should enact environmental concerns.[2] For instance, such concerns are mentioned as part of the code of ethics for the global consulting engineering industry through FIDIC. In this code of ethics, environmental concerns have a prominent place. First, the overall rule is to "accept consulting engineers' responsibility to society". The next rule is to "seek solutions that are compatible with the principles of sustainable development".[3] Also, the Norwegian RIF stresses that engineering companies has a responsibility toward society, which is described through nine principles. The second principle is to "work actively to ensure the projects quality, including intervention on physical environment, work environment and safety concern".[4] Also, according to its web pages, RIF has for many years been a driving force to make environmental issues central to the consulting engineering business, in particular the building and construction industry. The association has, for instance, in collaboration with the construction industry, established a general office and a website for environmental issues relevant to the construction industry, where the purpose has been to give advice and strengthen the knowledge about and practice of green design. Thus, it seems to be a widespread desire within the profession and the industry to make important areas of consulting engineering more sustainable. Do consulting engineers succeed in reaching such goals? How do such companies engage with environmental concerns, and why?

Re-assemblages of environmental concerns

We want to address these questions through studying different *assemblages* of practices, actors and ideas in relation to consulting engineers' environmental concerns. The

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[1] Davis, *"Thinking like an engineer,"* 1991; Pritchard, *"Professional standards in Engineering Practice"*, 2009.
[2] http://www1.fidic.org/about/ethics.asp and http://www.rif.no/default.asp?id=123&hl=samfunnsansvar#hl
[3] http://www1.fidic.org/about/ethics.asp
[4] http://www.rif.no/default.asp?id=123&hl=samfunnsansvar#hl

concept of assemblages is inspired by Latour and actor-network theory.[5] Actor-networks are hybrid associations between heterogeneous actors, human and non-human. In Actor-network theory practice or actions are understood as being distributed among a variety of actors in potentially complex ways. The idea underlying this theoretical frame of analysis is that we may provide an understanding of consulting engineers and their ways of enacting environmental concerns by analyzing the complex associations made between the elements of consulting engineers' practices and on the basis of this, re-assemble the actor-networks that these companies constitute. In this paper, we are particularly interested in the extent to which environmental concerns are important in these actor-networks, and, eventually, the effects of such concerns on the associations of consulting engineering companies. What kinds of elements are integrated in the actor-network when consulting engineering companies try to provide environmentally sound solutions to their costumers?

Previous research that are relevant to our research questions, suggests that there may exist three different assemblages that consulting engineers may enact when they try to make their services sustainable. Two of these assemblages are seen to facilitate the promotion of environmentally sound solutions; we have chosen to call them the assemblage of ethics and the assemblage of business strategies, respectively. The third one is seen as impeding the consideration for sustainability. We have called this the assemblage of engineers' practices. Since they are constructed from previous studies, the three assemblages should be seen as providing analytical tools to help us to describe the main assemblages that are constructed by Norwegian consulting engineering companies.

Many argue that the features of what we call the assemblage of engineers' practices are dominant in the way consulting engineers approach environmental issues.[6] Consequently, we start by considering the elements of this assemblage.

I. Assemblage of Engineers' Practices

Consulting engineers offer so-called knowledge-intensive services.[7] However, the research literature describes the practice of consulting engineers as more problem-driven than actually knowledge-driven.[8] According to Koch, project learning and reflection is limited by the logic of the economy of the single project.[9] This logic, which he terms the "tyranny of projects"[10], implies that each project is seen as an entity that is supposed to be profitable. Consequently, it is difficult for consulting engineers to enhance knowledge production in and across projects because the severe economic limitations of the single project do not allow efforts other than those strictly necessary to fulfill the contract. In turn, this may impede the enhancement and development of knowledge about sustainable design among consulting engineers.

There are also other factors that may make environmental concerns become less salient in their work practices. Filiatrault and Lapierre have shown how the control of schedules and costs are interpreted as the most important sign of quality in the relationship between consulting engineers and their clients.[11] Further, Koch points to the complex division

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[5] Latour, *Science in Action*, 1987; Latour, *Pandoras Hope*, 1999; Latour, *Reassembling the Social*, 2005.

[6] E.g., Hubak, *"Synlig kostnad – Skjult gevinst,"* 1999; Ryghaug and Sørensen, *"How energy efficiency fails in the building industry"*, 2009..

[7] Filiatrault and Lapierre, *"Managing business-to-business Marketing Relationships in Consulting Engineering Firms"*, 1997; Koch, *"The Tyranny of Projects,"* 2004.

[8] Koch, *"The Tyranny of Projects,"* 2004; Alam, *"Commercial Innovations from Consulting Engineering Firms,"* 2003.

[9] Koch, *"The Tyranny of Projects,"* 2004.

[10] Koch, *"The Tyranny of Projects,"* 2004, p. 296.

[11] Filiatrault and Lapierre, *"Managing business-to-business Marketing Relationships in Consulting Engineering Firms"*, 1997.

of labor in the projects that consulting engineers participate in, demanding that consulting engineers cope with and balance various tensions and actors related to projects.[12] All in all, these features suggest that the space for consulting engineers to enact sustainability may be limited, unless it is explicitly desired by their clients. Also, engineers' capacity to make environmentally friendly decisions may be constrained by the corporate or organizational culture in which they work. [13]

Thus, the assemblage of engineers' practices is combination of associations that hampers innovation and thus renders the enactment of environmental concerns difficult and demanding. How did these elements play out in our study? Did the consulting engineering companies that we analyze experience their practice as more problem-driven than knowledge driven? Given that the companies are in a business where their revenues are based on the number of tenders won, in what ways do they face "the tyranny of projects" and how does this feature effect their engagement with sustainability? And, how did they experience clients' demands?

II. Assemblage of Ethics

As shown in the introduction, engineering companies' relations to sustainability may be interpreted as being influenced by engineering ethics. Engineering ethics is usually considered to be a field within applied ethics, which studies engineers' relations to society, to the public, to their clients, to their employers and to the profession itself. Engineering ethics has mainly been treated as an ethic for engineers as a *profession.* [14] Typical concerns have been issues like safety, health, welfare, conflict of interests, whistle blowing, honesty, etc. Sustainability has more recently been seen a part of that ethics, as previously indicated.

Ethical standards can result in goal-setting or prescriptive regulations.[15] According to Coeckelberg, prescriptive forms of regulation may be easier to follow and to check, but risk the disadvantage of becoming paper-making activities that impede an internalization of the norms that they are based on.[16] Goal-setting regulation offers engineers more freedom and autonomy, but perhaps also more uncertainty, and it is less easy to audit. In addition, consulting engineers have to consider standards of competence. These are standards that has evolved through engineering practice and presumably commonly accepted.[17] According to Prichard, regulatory standards and standards of competence are intended to provide some assurance of quality, safety and efficiency in engineering.[18] However, such standards call for professional discretion since they do not specify particular procedures or resourced to be used.

Another ethical rule that may be considered equally important in professional engineering is to follow legal technical codes and regulations. This is listed as the number one ethical concern at RIF's webpage: "do not participate in projects that break the law". 'The law' include technical codes that are legal requirements enforced by some governmental body, like for example building codes, sanitary codes, health codes, fire codes, etc. In Norway, Standard Norge[19] is the actor who develops standards for all domains in the Norwegian society, except tele- and electrical codes. Norsk Standard is a private and independent member organization, which traces its roots back to 1923. Membership is open for businesses, organizations, public authorities and others. Norsk Standard establishes

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[12] Koch, *"The Tyranny of Projects,"* 2004.

[13] Lynch and Kline, *"Engineering Practice and Engineering Ethics"*, 2000.

[14] Davis, *"Thinking like an engineer,"* 1991; Davis, *Profession, Code and Ethics*, 2002.

[15] Pritchard, *"Professional Standards in Engineering Practice"*, 2009; Coeckelberg, *"Regulation or Responsibility?"*, 2006.

[16] Coeckelberg, *"Regulation or Responsibility?"*, 2006.

[17] Pritchard, *"Professional Standards in Engineering Practice"*, 2009

[18] Pritchard, *"Professional Standards in Engineering Practice"*, 2009, p. 961.

[19] http://www.standard.no/no/Om-oss/

approximately 1200 new standards a year, where most is based on European standards, as the organization is the Norwegian member of the European Committee for Standardization (CEN), and the international equivalent, the International Organization for Standardization (ISO). In the environmental field, the Norwegian standards (NS) are meant to supply Norwegian laws and regulations, European Union directives and international agreements. The government composes the statutory framework and directives, for example for limit values. From there, parameters for sampling and measuring methods are defined in the standards (NS, ES and ISO). [20]

This kind of professional ethics is seen to be guided by predominantly individual and professional moral values.[21] While the main perspective on engineering ethics has been a philosophical one, lately, some has argued for broadening the scope of engineering ethics to include a more thorough analysis of the everyday practice of engineering[22] as well as the design processes of engineering[23] and for exploring the concept of ethics itself in a more deconstructive way.[24] Behind these suggestions lies a view that ethical questions are meaningful only within the context in which they appear, and thus that they should be studied in relation to these contexts.[25] This criticism fits well with a science and technology studies (STS) perspective, and some ethicists have also argued for bridging the fields of engineering ethics and science and technology studies.[26]

The main idea in this literature is to use the perspectives and tools of STS to open the 'black boxes' of engineering ethics. What can we learn by scrutinizing consulting engineers' practices in relation to environmental concern more thoroughly? What is considered to be environmental concern? What sort of practice is environmental concern? An STS approach would include a focus on the material aspects of ethics. What are considered to be environmental objects in their practice? What sort of material associations are made to environmental issues in their work?

van de Poel shows in his case study of design engineers how technical and ethical issues became inseparable and intertwined in their practices.[27] According to van de Poel, this was largely due to the fact that most problems the engineers encountered were "ill-structured", which meant that there was no criterion to decide the best solution to the problem. There were many trade-offs that needed to be made in relation to fulfilling the ethical requirements, and van de Poel argues that this situation was seldom made explicit or even recognized by the engineers. Rather, the engineers often did not perceive their role to be considering the moral issues or trade-offs that had to be done during the design processes. Instead, the engineers often proposed a division of labor where normative issues were to be decided by non-engineers like politicians, managers, etc.[28] They considered their own tasks to be morally neutral.[29] Others have argued that engineers need to take responsibility even

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[20] http://www.standard.no/no/Fagomrader/Miljo/Om-miljo/
[21] Herkert, *"Future directions in engineering ethics research,"* 2001; Lynch and Kline, *"Engineering Practice and Engineering Ethics"*, 2000; van de Poel, *"Investigating issues in Engineering Design"*, 2001.
[22] Lynch and Kline, *"Engineering Practice and Engineering Ethics"*, 2000.
[23] van de Poel, *"Investigating issues in Engineering Design"*, 2001; van de Poel and van Gorp, *"The Need for Ethical Reflection in Engineering Design,"* 2006.
[24] van de Poel and Verbeek, *"Editorial,"* 2006.
[25] van de Poel and Verbeek, *"Editorial,"* 2006.
[26] Davis, *"Thinking like an engineer,"* 1991; Johnson and Wetmore, "STS and Ethics," 2008: Lynch and Kline, *"Engineering Practice and Engineering Ethics"*, 2000; van de Poel and Verbeek, *"Editorial,"* 2006.
[27] van de Poel, *"Investigating Ethical Issues in Engineering Design"*, 2001.
[28] See Schinzinger, *"Ethics on the feedback loop"*, 1998.
[29] van de Poel, *"Investigating Ethical Issues in Engineering Design"*, 2001, p. 439.

beyond the codes of ethics, for example by encouraging others to follow such codes, or by criticizing or otherwise calling to account those who do not.[30]

We see the assemblage of ethics as consisting of many elements – including standards and regulations – that facilitate, even demand that consulting engineers make their practice sustainable. In our study, we ask in what ways consulting engineering companies perceive as their responsibility to provide sustainable designs. Moreover, given that Norwegian consulting engineering companies should be inclined to experience governmental regulations as an important part of their consulting engineering practice, what role do these regulations actually play? To what extent do the companies choose to move beyond the technical codes and regulations in order to satisfy environmental concerns? And what role do prescriptive and goal-setting regulations play in their practice?

III. Assemblage of Business Strategies

A different perspective on consultant engineering and sustainability is represented by research that focus on the individual *company* and its commitment to environmental issues. Within business, management and organization studies many contributions analyze how managerial, administrational and organizational factors may affect companies' commitment to environmental issues. The underlying belief is that companies may play a major role in addressing environmental problems by way of instituting better management practices. The expectation is that firms will have strong incentives to do so, first of all because they are influenced by many external stakeholders, like customers, socially concerned investors, environmental interest groups and governmental regulators.

According to Henriques and Sadorsky, external stakeholders can influence the practices of an organization via direct pressure or by conveying information. In their study of environmental strategies and practices among Canadian firms, they found that firms are most likely to take on an active environmental role when they are influenced by regulatory stakeholders, including government and trade associations.[31] Other, less important stakeholders were organizational stakeholders (including customers), community stakeholders and the media. Based on this we would expect regulations to play a vital role for consulting engineers environmental practices, as also suggested in the assemblage of ethics.

The assemblage of business strategies contains elements related to the way companies are managed. Companies will often find it necessary to comply with standards and regulations to satisfy external stakeholders. Also, as suggested by the literature on corporate social responsibility[32], companies may find it useful to implement environmentally friendly business strategies as part of their marketing and public relations efforts. How does this play out for consulting engineering companies in Norway? Do they see better management practices as a means to address environmental concerns? What pressures and stakeholders do they identify as influential with regards to implementing environmental concerns?

Thus, the three assemblages outlined above should help us to analyze to what extent Norwegian consulting engineering companies enact environmental concerns as a blend of knowledge-based *and* moral performances, as torn between "the tyranny of projects", business strategies and ethical or value-based considerations. To begin with, we did not expect any of the three assemblages to actually represent the practices of the companies. Rather, we expected actual practices with respect to sustainability to be acts of balance with a variety of outcomes. In the rest of this paper we investigate such acts of balance by analyzing how consulting engineering companies perceive their own responsibilities as well as their

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[30] Davis, *"Thinking like an engineer,"* 1991.

[31] Henriques and Sadorsky, *"The Relationship between Environmental Commitment and Managerial Perceptions of Stakeholder Importance"*, 1999.

[32] Cerin, *"Where is corporate social responsibility actually heading?"*, 2004

abilities to deal with environmental concerns. To what extent do they see themselves as engaged with environmental concerns and trying to implement such concerns in their day-to-day practices? And *how* do they enact such concerns?

Method

Consulting engineering activities comprises a wide range of engineering work. They do tenders, design, advice and reviews as well as project management and administration, construction management and management of design groups. A consulting engineer is usually defined as an occupation that is related to doing consulting engineering work and being a member of a professional association, which in the Norwegian setting is RIF. Credibility is largely established by becoming a member of such a professional association. National associations are usually also members of international professional associations for consulting engineers, in this case FIDIC (The International Federation of Consulting Engineers) and EFCA (European Federation of Engineering Consultancy Associations). Membership in RIF can only be obtained by a company, but one can be certified by RIF as an individual consulting engineer.

According to RIF's website,[33] the requirement for becoming a certified consultant engineer is a B.Sc. in engineering and relevant practice and knowledge within RIF-approved areas, like legislation and regulations, design processes, EHS (environment, health and safety), relevant management practice, good references from clients, good collaboration and communication skills, skills in consulting practices, a conduct in agreement with RIF's norms for business practice and knowledge about RIF's regulations and requirements for membership. The approval to become a member is made by a committee set up by RIF. A large majority, approximately 80% of consulting engineer companies in Norway are members of RIF.

Thus, we chose to analyze companies that are RIF members and initiated a collaboration with the association for help to get access to companies to participate in our study. Of the 275 member companies in RIF (employing about 7 200 people) we selected a sample of 40. The selected firms varied in size. 15 (37 %) had less than 10 employees, 19 (46 %) between 10 and 100 employees, while 7 companies (17 %) had more than 100 employees. This we believe to be fairly representative of an industry with many small enterprises, but also with a few fairly large and influential firms. The majority of the companies worked with construction and buildings, some specialized in HVAC, some in project management, etc, while the large ones covered many specialties.

When assessing the use of telephone interviews or face-to-face interviews one has to see this in light of the research question and the imagined respondent group. Telephone interviews can mean savings as one does not have to travel, but this only makes sense when the data is of sufficient quality.

Telephone interviewing has been subjected to some concerns.[34] First, such interviews are criticized for being short and not able to provide "rich enough" material. In this sense it is presented as a form of hybrid between the qualitative interview and a survey. Second, telephone interviews are seen as challenging since they lack non-verbal communication. Finally, they are regarded as simplistic and unable to capture diversity. However, recent literature on telephone interviewing claims that this interview mode is suited for brief instrumental interviews as well as longer expressive conversations.[35]

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[33] http://www.rif.no
[34] Shuy, *"In-Person Versus Telephone Interviewing"*, 2009.
[35] Christmann, *"Expert Interviews on the telephone,"* 2009; Shuy, *"In-Person Versus Telephone Interviewing"*, 2009; Sturges and Hanrahan, *"Comparing Telephone and Face-to-Face Qualitative interviewing,"* 2004.

Although we did face the problems mentioned above,[36] especially regarding the lack of non-verbal communication cues, these issues did not really affect the quality of the interviews. Rather, interviewing by telephone instead of in-person made it possible to focus even more on the follow-up questions and places to probe. As a result, our interviews gave us plenty of insights into the knowledge production and knowledge practices among consultant engineers, with a particular focus on environmental knowledge. The respondents shared a great deal of information, not only on the topics that we asked about, but also their understanding of aspects like driving forces, engineering education and practice. Although the interview guide included questions producing "easy to score data"[37] the interviews came out very rich in descriptions because we had many open-ended questions and probes. For example, the mix of open-ended and close-ended questions made many of our interviewees elaborate their experiences and views even on close-ended questions.

We contacted the firms via email addresses found in the RIF database, which allows one to sort companies by discipline and/or geography. Many firms cover more than one discipline. The choice of firms was made to achieve variation in terms of companies' size, disciplinary field and geographical location. Where possible we contacted the managers directly through e-mail. However, some firms, especially the larger ones, did not offer direct personal email addresses. In these cases we sent the email to the company's general email address or made a phone inquiry. Mostly, we established contact with the general manager. In a few cases we interviewed someone else in the companies' management. Very few declined to be interviewed. Only one firm declined altogether, while one other company had recently been dissolved and therefore was unable to participate. In these two cases we selected other similar firms.

The telephone interviews were carried out during a period of two months in 2009. They lasted from half an hour to an hour and followed a semi-structured interview guide. We asked interviewees about how they saw environmental issues to be related to their work and what they did to implement environmental concerns in their practice. We also asked them what they considered to be important factors and/or driving forces with regard to environmental concerns. Finally, we inquired about important sources of knowledge within as well as outside the company and the responsible person(s) for doing environmental concerns.

Since we only interviewed one person, usually the manager, from each company, one may ask about the representativity of the answers provided. However, our main interest is to be able to characterize the consulting engineering industry and not to provide a correct picture of each company.

The interviews were taped and transcribed in verbatim, and the quotes have been translated to English by the authors. The analysis of the data has been inspired by grounded theory methodology based on open coding.[38] We have been using a software program, ATLAS.ti. We developed axial codes for this particular paper based on some of the questions above, for instance what they did to implement environmental concerns in their work. From the answers we identified categories across the data, e.g., like 'waste-management' or 'fulfilling regulations'. Such categories served as basis for the analysis.

In the following section, we start out by investigating how the studied consulting engineering companies 'do' environmental concerns. How important were such concerns? We continue by analysing the underlying motivation to engage with environmental concerns. Finally, we study what our respondents identify as barriers for making environmental concerns in their practice.

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[36] Shuy, *"In-Person Versus Telephone Interviewing"*, 2009.
[37] Christmann, *"Expert Interviews on the telephone,"* 2009, p. 166.
[38] E.g., Strauss and Corbin, *Basics of Qualitative Research*, 1990.

'Doing ' Environmental Concerns

    We used previous research on these topics to construct three assemblages, where engineers' practices, ethics and business strategies were made into a respective centerpiece. The underlying idea was to see if the associations made by the consulting engineering companies that we analyzed would map onto one or more of these assemblages. What we found was that all of the above-mentioned three assemblages were salient. This meant that when we tried to re-assemble companies' associations,[39] we encountered hybrid assemblages as well as companies that did not find environmental issues important at all. However, the main formatting feature of the enactment of environmental concerns was to follow regulations and codes. The following exchange was typical:

        I: How are environmental challenges visible in the work you do?

        R: Well, it is visible in the sense that we are delivering projects, which are to satisfy relevant regulations, the legal requirements that consist of laws, which regulate this. And we have underlying requirements and instructions. So when we're involved in projects, we make sure that they're performed according to prevailing laws, and that the environment is attended to in the way regulations and laws demands. We don't do environmental projecting for the sake of the environment, you see?

        (CEO, small company, construction and hydro power station design)

    To enact environmental challenges was to deliver solutions in accordance with regulations and professional standards. Thus, environmental concerns and the strategy to enact sustainable designs were largely constructed through interpretations of the existing legal framework, instructions and certifications. Consider, for example, the following exchange, where the interviewee emphasized that for his company, having an "environmental profile" precisely meant to fulfill regulations:

        I: In your view, how are environmental concerns attended to in the projects?

        R: Well, that is to follow the [governmental] requirements, the basis, and the new regulations. Technical building code requirements and so on.

        I: Do you, as a company, focus on environmental issues?

        R: Yes, or, that depends on what you put into it? We are engaged in such issues, we really are.

        (Regional manager, large company, installation and HVAC)

    This company obviously perceived fulfilling existing regulations as the adequate way to do environmental concerns. The respondent asserted that they *were* really engaged in environment and that to fulfill existing regulations and being conscientious about them, was a token of that concern. In a sense, they appeared to be in the business of following legal rules and standards, rather than promoting sustainability as such. Another main finding was that the doing of environmental concerns predominantly was considered a very practical question. Almost every interviewee related environmental concerns to some practical activity relevant to the field in which they worked. This could be preventing pollution, using certified materials, proper handling of hazardous waste, keeping interventions into landscapes to a minimum, recycling waste and redundant materials at building sites, and also making the required investigations to make sure that building sites do not have a polluted ground:

        I: How do you mean environmental concerns are best done in your work?

        R: Well, since I work mainly on the construction management side, it would be about protecting and doing the intervention on the site as careful as possible and make sure to

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[39] Latour, *Reassembling the Social*, 2005.

minimize the pollution while we are doing it. Also, to achieve source segregation and make sure that the machines are certified and in order. (CEO, small company, construction design)

Other examples of environmental activities were the selection of environmentally friendly materials when projecting and designing solutions with a low level of energy consumption, workers' safety at the construction site, to have waste plans and plans for dealing with technical equipment, as well as making descriptions and drawings and plans to deal with environmental aspects of a construction process:

R: First, in a building project it's really important to safeguard the working environment. (…) Then, there's the importance of waste plans and how the environmental engineering is attended to on the site. So environmental concerns are becoming an increasingly bigger part of the projects and have become a topic early in the process of every construction project.

I: Yes? How do you specifically work with this then?

R: We're involved in preparing the descriptions, drawings and plans for how the building process should be done. So, when we invite entrepreneurs to tender, we have included all this, HMS-plans and environmental plans and waste management plans. How these aspects should be handled.

(Group manager, medium sized company, construction design and HVAC)

Thus, to many it seemed that that doing environmental concern was about making sure that their work processes were environmentally friendly and safe rather than to achieve sustainable designs.

Initially, we thought that innovation and new knowledge could be a driver for environmental concerns. This would also be in line with premises underlying the assenblages of business strategies. Obviously, sustainability may require innovation because one may need to change established approaches or methods or to develop new ones. According to Jensen et al.[40], there are two main drivers of innovation – R&D or experience and recognized problems with current practices. The former is based on the production and use of codified scientific and technical knowledge. The latter relies on informal processes of learning and experience-based know-how. Jensen et al.[41] show that these drivers may compliment each other and that they are needed to promote innovation. To what extent was new knowledge emphasized in the considerations of our respondents?

Perhaps surprisingly, the interviewees did not mention innovation in response to our questions about how they engaged with environmental issues. Moreover, they seldom mentioned new knowledge as a driver, even if a few told that they occasionally needed to recruit new people with better competence to deal with the challenges related to providing sustainable solutions:

I: Do you focus on environmental concerns?

R: Yes, were trying to build it [the competence to deal with environmental challenges]. We have started to hire people with a relevant background to work with such problems. We don't expect to become environmental just by talking about it. We need to engage in such activities and to have people in the company who know about the environment and who can front these issues outwards. And who can make demands on consultants and follow up on those demands. So, we are working seriously with this.

(CEO, large company, project management within construction and infrastructure)

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[40] Jensen et al., *"Forms of Knowledge and modes of innovation"*, 2007.
[41] Jensen et al., "Forms of knowledge and modes of innovation", 2007.

Some also stressed that projects required knowledge and competence "on both sides of the table" in order to successfully implement an environmental concern:

> I: Do you feel it's important to attend to environmental concerns in the projects you work on?
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> R: Yes, it is. The environmental aspects are an important premise, a framework, and an important basis for many of the projects we're involved with.
>
> I: In your view, how is environmental concerns best attended to?
>
> R: Well, a lot of what has to do with environmental issues is in many ways regulated by the type of project you work on. And that again of course requires competent people, on both sides of the table, it requires that everyone knows what they're dealing with:
>
> I: Do you mean both yourselves and the client?
>
> R: Yes.
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> (CEO, medium sized company, infrastructure design)

Actually, environmental issues were seen as being integrated in flux, as part of the development and not as requiring particular activities in order to gain any new knowledge. The exception was hiring new employees with relevant competence.

To sum up, the interviewees mainly interpreted environmental concerns by reference to legal requirements. This was accounted for in a matter-of-fact like way. In the construction of the assemblages of ethics as well as business strategies, compliance with regulations was seen either as an ethical issue or as related to a concern for external stakeholder. Neither of these ways of reasoning was evident from the accounts of our respondents. Was the motivation for doing environmental concerns just to be law-abiding, or was there something underneath?

Motivation for Doing Environmental Concerns

Given the present emphasis on environmental issues, not the least climate change, we expected consulting engineers to consider sustainability as an important issue to their companies. We anticipated environmental concerns to be something every consulting engineering company needed to deal with since sustainability is an important part of the ethics of the profession, but also because it could be an important ingredient of the business plan of the company. Was the rather reactive mode of following regulations typical of the way consulting engineering companies dealt with environmental concerns?

The answer is yes, but with important modifications. There *were* some respondents who expressed a more pro-active stand and articulated an aim to go beyond fulfilling the regulations. One said that they had actually fought in order to improve the existing regulations, because they did not considered them to be good enough:

> R: If you fulfil the legal requirements today, the result will turn out quite good [in terms of sustainability]. So there's no need to, so to speak, to fight for it today. Before, on the other hand, we had to stand up against building codes, which we found insufficient. We said 'these regulations aren't good enough'. (…) All the time, we said 'This isn't good enough'. We felt that we were building something that wasn't up to standards. And today we can watch the news and see all these public buildings, schools that are useless to the pupils because they get headaches from being detained in such poorly designed buildings. And that's a product from the days when the building regulations were insufficient. And the consultants and those building the constructions failed to convince the builders to go for better solutions. So after the regulations improved in the nineties, I say it's not that bad. And there are of course those who even go further than this, and build even better than the regulations requires.

(CEO, small company, HVAC and energy technology design)

According to this respondent, current regulations provided for sustainable products if one followed the codes. Moreover, this respondent also observed that some companies actually went beyond regulations in order to construct even better buildings, but he did not include his own company in this group. Thus, to some, their doing of environmental concerns seemed to be driven by a wish to get better regulations, which in turn could be an expression of a more general concern for the environment.

Also, the anticipation of an increasing demand for more environmentally friendly products from clients was a driving force for many companies. This demand was met by different means. One of them was certification, the fulfillment of requirements set by some outside, well-established authority:

> I: In your view, how are environmental concerns best attended to?
>
> R: Yes, that is to be on guard with regard to those environmental consequences that can possibly occur. We are in the process of being environmentally certified and will probably be fully certified during 2009. That means we're in a preparatory phase in the whole company, were we are a piece. At the same time the consultants possibilities to affect clients with regards to environmental concerns are limited, at least as long as they are already inside the legal boundaries.
>
> (…)
>
> I: Right, so it's a new kind of certification?
>
> R: It is a new kind of certification, which relates to the environment and the environmental aspects of society, and it adapts to the consulting activities that we do and the disciplines we are concerned with. What we see is a growing demand amongst municipalities and counties and governmental institutions that commission our services, for increased documentation of environmental management, environmental requirements and follow-up plans on environmental aspects. So, there is no time to waste and only for us to start the work.
>
> (Regional manager, large company, construction design and project management)

Thus, the concern for the environment may be mediated through concrete evidence of such concerns, like the anticipation of the growing demand for documentation, certifications, etc. from the authorities. Another company admitted that they quite recently became more conscious about environmental issues and planned a more comprehensive strategy for attending to environmental problems:

> I: Is there a focus on environmental issues in your business?
>
> R: I would say yes. We are preparing a larger environmental strategy for the firm. And we do in some ways work with environmental aspects. But we might not have been very conscious until recently, that our projecting has some environmental consequences.
>
> I: Yes. Do you feel your business engage sufficiently with environmental issues?
>
> R: Well, I really think our consciousness [with respect to these issues] has grown recently. There's a lot of focus on energy, different energy sources. As of August 2009 the new official requirements on energy sources will come into operations, with new demands on energy supply.
>
> I: Yes?
>
> R: At least forty percent of the energy supply has to be provided by other energy sources than oil, electricity and natural gas. For us, that involves a greater use of heat pumps. So that is something we are preparing for. (Consultant engineer at regional office, large company, HVAC)

Their new environmental strategy was an anticipation of the new demands and regulations. Again, we see the importance of regulations in order to spark new awareness and initiatives. Still, what these companies had in common was an engagement in environmental issues that went beyond just fulfilling the legal requirements. It reflected their belief that they had something to contribute to an improved handling of environmental concerns, and they made substantial efforts to sell sustainable solutions to their clients. We could see this as an outcome of business considerations.

Some companies were also pro-active in the sense that they had their own view of what were the best environmental solutions and actively tried to sell them to clients:

I: Do you think it's important to attend to environmental concerns in the projects you work on?

R: Yes, we do, absolutely!

I: Yes? How do you work to achieve this?

R: Well, we work, in a way I generally try to be engaged in environmental issues, and environmental conditions with regards to buildings. And to the degree I can sway the client to make environmental considerations, I will. Usually one is involved in projects, which is already given some limits with respect to environmental concerns. It is already, someone has already made for example an environmental follow-up plan. Such things. So it all depends on when we're involved in the project. (…) I would really like to use more of my time to be involved in, manage projects and such, [with regard to] environmental concerns. But often it has to be voluntary, based on voluntary work, as the company itself is billed. Stuff I can't bill others. It has to be billable. So to the degree one can bill it to projects, that's good. But it has to be said that there are very few projects with such stated environmental goals. (…). That is very rare. But I think it's important, yes. It's very engaging.

(Consultant engineer, small company, construction design and project management)

This respondent showed a great deal of personal engagement, but this interest in making environmental solutions was obviously hampered by the limitations of the project. The possibility of pursuing sustainability depended on explicitly stated environmental goals. Consequently, the *phase* in which they entered a project was important. If they entered at an early stage, they might negotiate better environmental criteria than if they came in later.

Thus, environmental concerns could be seen as part of consulting engineering companies' business plans. Actually, based on the previously reviewed literature on environmental management commitment we could expect the companies to use sustainability as way of marketing themselves toward the customers. Was this the case?

To some extent, we found this to be true. Consider the following exchange, which also exemplifies a need to 'sway' clients to choose sustainable solutions:

I: In your view, how are environmental concerns best attended to?

R: Environmentally friendly materials, and sustainable systems.

I: What do you mean by sustainable systems?

R: To sway the builder to go for sustainable energy-sources.

(CEO, small company, HVAC)

But again, codes and regulations played an important part because they were seen to facilitate the selling of environmental solutions to clients:

R: [Public regulations] are what run the operations. If it's not required by the authorities or demanded by builders, then … And the governmental builders are quite large, both within transport and house construction and other projects. So, demands have to be made

[by codes or legal standards].

I: Yes?

R: No one will be willing to pay for these measures if the authorities don't require them …

I: Right.

R: … Through laws or by the builder himself.

(CEO, small company, construction design and quality controlling)

What we see here, is a different reasoning with respect to environmental regulations. Rather than being a matter of law-abidingness, regulations were presented as needed to make clients willing to pay for environmentally friendly solutions:

At the same time the consultants' possibilities to affect clients with regards to environmental concerns are limited, at least as long as they are already inside the legal limits.

(Regional manager, large company, construction design)

To be fair, in some cases clients were described as the ones who expected or wanted environmentally friendly solutions and also as the most knowledgeable with regard to such issues:

I: How do you integrate environmental aspects into your business?

R: Well, it's more of a flowing integration, so to speak. Follow the developments. It comes naturally really, I think our clients are very knowledgeable and wants it [environmental aspects], so it's actually guaranteed to be a part of the projects.

I: Could you give some concrete examples?

R: Yes, for example we have one of the largest projects we are currently working on, building a factory. The client requires that the building is going to have the lowest emissions possible. They demand that fossil fuels are not to be used in projects they are involved with. So yes, that is probably the best example I can give, where they have a really clear environmental profile.

(CEO, medium sized company, HVAC)

Actually, some companies said that they did not consider it their responsibility to manage environmental issues. This belonged with their clients:

I: In your business, who manages and is responsible for environmental knowledge?

R: We don't have someone in particular who's responsible for these aspects.

I: No? Who takes initiative to make use of environmental knowledge and technology in projects?

R: Mostly our clients.

(CEO, large company, design energy grids, plans and networks)

Engagement with sustainable designs could also be fuelled by *professional interest.* This is exemplified by the quote below, where a technical interest was combined with the desire to provide environmentally friendly solutions:

I: Have you ever, say, tried to sell [environmental solutions]?

R: Well, yes. We have one project, which we've sold to a client, which involves reuse of concrete constructions. It was a building, which was going to be demolished in the harbor, when building a new terminal at the pier. A really nice warehouse building was

being teared down. A huge warehouse. Put up in the eighties and hardly used. So, we have a client who's bought these concrete elements. They are in storage. So we're going to make a project for him where we get them up again. So, that is re-use of concrete elements in its purest form. And I'm really excited about it.

(Consultant engineer, small company, construction design and project management)

However, such co-production of environmental concern and technical interest was rare. The main drivers for doing environmental concerns were elsewhere. In the first instance, environmental issues were seen as important because of governmental regulations. However, the willingness to comply with regulation was – at least not explicitly – related to ethical considerations but rather driven by their business strategy. These strategies could also include the anticipation of stricter legal rules as well as increased demand from customers. Thus, the assemblage of environmental concerns would by shaped by business strategies rather than ethical thinking or an articulated professional interest, even if the latter was found in a few cases. What then was the role of the elements of the assemblage of engineers' practice, argued previously to be hampering the doing of environmental concern?

Limitations for Doing Environmental Concerns

Although a great majority said that their companies focused on environmental issues, six of the interviewees said that such issues were not important to their firm and several were cautious about the actual strength of the engagement. For example, one said that it was not a main focus in their company, but an 'added concern'. Thus, the actual engagement with environmental issues varied quite a lot and more than we anticipated. To a great extent, this lack of being pro-active was caused by economical considerations and the "tyranny of projects", as suggested in the outline of the assembly of engineers' practices:

The challenge is in a way to persuade … It all comes down to money, no matter how you twist and turn it. It is about convincing actors in the building industry or those who are going to pay the bill that it is sensible to use that particular material because it pollutes the building site less or because it causes minimal pollution during production. But it's not easy. Because the person building a house wonders why he should spend a thousand kroner more per square meter to use that specific material. Some might think about it, but it is still a small percentage of those who build who do.

(CEO, medium sized company, construction design and project management)

Many considered the implementation of environmentally friendly design a challenge because of costs. The clients needed to be persuaded to allow the consulting engineers to take on board environmental considerations such as choosing more expensive but non-polluting materials. Some of the companies claimed little autonomy with regard to environmentally friendly designs because customers decided and because other parties made the important decisions. :

Further, while the majority of the companies said they did enact environmental concern in some way there was a substantial interpretative flexibility regarding what that meant. Concern for the *environment* as such was not commonplace. In fact, as we saw previously, some interviewees explicitly announced that environmental concern for them was *not* about protecting the environment as such, but merely being about the fulfilling of regulations:

I mean, we do everything that is necessary to satisfy the regulations. As I said, we don't do this because we're personally interested.

(CEO, small company, construction design and quality controlling).

A main limitation for doing environmental concern was actually 'the tyranny of the project'.[42] Cost considerations and the phase when they entered the project were seen as the critical factors. However, 'the tyranny of the project' was not always a limiting factor. Actually, legal regulations played an intriguing and productive role in making environmental concerns into a consulting engineering business.

The Business of Complying with Regulations

We noted in the introduction that consulting engineers have a key role in making modern societies more sustainable. Did our respondents' accounts show that their companies took on such responsibilities? We observed the theoretical possibilities of three assemblages – of engineers' practices, of ethics and of business strategies – that could have been reflected in the companies' own enactments. How were these assemblages played out among the consultant engineer companies?

First, the practice of doing environmental concerns was most immediately associated to the act of fulfilling legal regulations. Technical codes and regulations played a crucial role in defining what it meant to do environmental concern. Codes and regulations specified design criteria as well as making particular demands on work processes, and the respondents claimed that their companies implemented the relevant legal environmental framework. The respondents did not associate explicitly to ethical arguments to account for this. To be law-abiding seemed self-evident. To work according to laws and regulations was considered competent practice. However, laws and regulations were also associated with business opportunities, above all because the legal rules were turned into marketing devices. Customers had to comply and commission sustainable designs because that was the law. What was the driving forces then?

Mainly, environmental concerns were perceived as important and as something the companies had to deal with in their daily work. However, they did so to a varying degree and with a diverse set of motives. Most of the companies could be characterized as reactive with respect to environmental issues. Only a few were more proactive in persuading clients to choose sustainable designs. What made the consulting engineering companies engage with environmental concerns?

Some expressed explicitly that their concern for environment was purely a matter of doing one's job properly and did not involve a concern for the environment as such. Others reported a sense of engagement and excitement for making sustainable solutions, but that seemed rather to be the outcome of a professional and technical interest than a political or ethical engagement with sustainability. Thus, our findings seem to be in line with van de Poel's assertions about engineers not seeing themselves as the main stakeholders for protecting the environment, but as technicians doing their job.[43]

In addition, consulting engineering companies could be caught in the "tyranny of projects", being constrained by other actors in the projects as well as strict cost considerations.[44] Some companies claimed for such reasons to be unable to influence projects in a more sustainable direction. However, in many accounts, the clients' role became ambiguous. Sometimes clients demanded environmental solutions, thus becoming a driving force rather than an obstacle. Sustainability could also be business.

This is important with respect to the analytical implications of third assemblage, which was constructed from associations related to business considerations. It indicated that environmental concern could be an important aspect of the business strategy of these companies, that they could make the selling of 'green designs' an important part of their

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[42] Koch, *"The Tyranny of Projects,"* 2004.

[43] van de Poel, *"Investigating Ethical Issues in Engineering Design"*, 2001.

[44] Koch *"The Tyranny of Projects,"* 2004.

business.[45] This was very much the case. Many companies reported that the anticipation of customers' increasing demand for greener design had made them prepare to meet that demand. Many also reported that they already experienced such an increasing demand. In addition, they anticipated new regulations and certifications from stricter environmental concerns environment among public stakeholders, like municipalities and other authorities.

Thus, the main assemblage constructed by the consulting engineering companies was a transformed hybrid of all the three theoretical ones. Companies linked in with compliance with legal regulations, but this compliance was translated into business opportunities. Moreover, while "the tyranny of the project" was used as an excuse for not engaging more strongly with environmental designs, at the same time the effect of "the tyranny of the project" was moderated by compliance with respect to legal rules. Thus, when re-assembling[46] the main associations made by the companies with respect to environmental concerns, we find that the resulting assemblage may be called *the legal compliance as business.*

This assemblage may of course depend on companies acquiring new knowledge and engaging with green innovations. However, we observed few traces of R&D, and the interviewees did not really talk about new knowledge or innovation. Rather, the actual doing of environmental concerns involved almost entirely a practical approach based on a problem-solving mode of thought.

The importance of codes in engineering practice has been stressed by previous research.[47] However, our observation of an assemblage of legal compliance as business provides a different emphasis in the subsequent focus on the way legal compliance becomes instrumental rather than a normative issue. While we do not deny the importance of normative aspects, the pragmatism of the way the consulting engineering companies engage with environmental concerns is striking. But than again, such pragmatism is not uncharacteristic of engineers.[48]

Of course, this has implications for environmental policy. Put simply, legal codes and regulations seem to be effective instruments to shape practices like those of consulting engineers. The instruments often preferred by economists – taxes – seem to have less impact. At least there were no references by our respondents to taxes as facilitating more sustainable practices.

Acknowledgements

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[46] Latour, *Reassembling the Social*, 2005.

[47] Henderson, *"Building Codes,"* 2006; Pritchard, *"Professional Standards in Engineering Practice"*, 2009; van de Poel, *"Investigating Ethical Issues in Engineering Design"*, 2001.

[48] van de Poel, *"Investigating Ethical Issues in Engineering Design"*, 2001.

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